# VIII. *On the Fossil Mammals of Australia.*—Part VIII. *Family* MACROPODIDÆ: *Genera* Macropus, Osphranter, Phascolagus, Sthenurus, *and* Protemnodon. *By Professor* OWEN, *F.R.S. &c.*

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§ 1. *Introduction.*—Through the adventurous journeys of JOHN GOULD, F.R.S., in the wilds of Australia, and by the noble works * in which he has given the results of his zoological observations in that continent and the adjoining island of Tasmania, we mainly know the extent and kinds of variation under which the Kangaroos there exist.

The present communication gives part of the researches into the forms of those saltatory herbivorous Marsupials which have passed away, or, at least, are known to naturalists only by their fossil remains. I shall be happy if I am able to complete a work which may be regarded as worthy to rank as a supplement to that of my old and esteemed friend and fellow labourer.

As the extinct species which I now attempt to define (their restoration awaiting further materials) have chiefly been made known to me by their fossil jaws and teeth, some remarks on the latter organs will be briefly premised.

The dentition of the Kangaroos (bilophodont *Macropodidæ* †) is summarily described and figured in my 'Odontography' ‡: in later works § its phases of development and mutation are exemplified in detail in *Macropus major* ‖. The last phase delineated (Anat. of Vert. vol. iii. fig. 296, F) is that which is shown in the subject of figs. 15 & 16, Plate XX., in the mandible of *Macropus major*, in which the anterior of the four retained molars ($d_4$) is "nodding to its fall." I have seen a specimen of an older Kangaroo of this species in which the series of grinders was reduced to two, viz. $m_2$ and $m_3$. Fig. 15, Plate XX., is also introduced to exemplify the largest size of mandible to be derived from any known existing kind of Kangaroo. The other figures in that Plate

* Those which relate to the present Paper are:—Monograph on the Macropodidæ, or Family of the Kangaroos, folio, 1841–42; The Mammals of Australia, folio, 1845–54.

† This is a section distinct from the Kangaroo-rats, Bettongs, &c., with quadrituberculate molars, included in the subfamily *Hypsiprymnidæ*.

‡ 4to, 1840–45, pp. 389–393, pls. 100, 101, 102.

§ Art. TEETH, in 'Cyclopædia of Anatomy,' vol. iv.; also 'Anatomy of Vertebrates,' 8vo, vol. iii. p. 380, fig. 296.

‖ I have always referred to this large and first-discovered species of Kangaroo under SHAW's later name (General Zoology, vol. i. pp. 505, 800). Mr. WATERHOUSE alludes to it sometimes (as in p. 52 of his excellent 'Natural History of Mammalia') as *Macropus major*, sometimes as *Macropus giganteus* (*ib.* p. 55), the synonym of ZIMMERMAN's *Jerboia gigantea* (1777) and of SCHREBER's *Didelphis gigantea* (1778).

show modifications in the size, form, structure, and order of succession and shedding of teeth requisite for the description and comprehension of characters of fossil jaws and teeth of the present family of Marsupials.

Thus, in *Macropus* (*Osphranter*) *robustus*, Gd. (Plate XX. figs. 13 & 14), the premolar (*p* 3), which is not larger than that in *Macropus major* *, is later retained; and the following molar (*d* 4) in my subject had undergone a much greater degree of wear than in *Macropus major* before *p* 3 had risen into place. This is plainly shown by the lower level of the much-worn *d* 4 in fig. 13. It would also seem to have been originally a relatively smaller tooth than its homologue in the "greater Kangaroo." The last molar is in place, and shows the same slight degree of masticatory wear in both species; but with this the molar series is reduced to four teeth in one, and shows five teeth, or four and a half, in the other.

In *Macropus* (*Halmaturus*) *ualabatus*, Less. & Gd. (Plate XX. fig. 11), the premolar (*p* 3), which is relatively larger than in the two preceding Kangaroos, has risen into place before the crown of the following molar (*d* 4) was worn down to its base. The hinder thickened end of *p* 3 is worn nearly level with the more complex grinding-surface of *d* 4, which nevertheless indicates, by the extent of exposed dentine, that it had been in use when the deciduous predecessors (*d* 2 and *d* 3) of the premolar (*p* 3) were in place. The last molar is here fully developed; its front lobe is abraded, and the series of five teeth are in a condition to continue together the work of mastication for a great part, at least, of the lifetime of this smaller kind of Kangaroo.

In the Red-necked Kangaroo (*Macropus* (*Halmaturus*) *ruficollis*, Dm., Gd.) (Plate XX. figs. 9 & 10) the penultimate molar (*m* 2) is in place and use before the first two deciduous molars (*d* 2, *d* 3) are shed, and when the premolar (*p* 3) is concealed, with the two roots as yet unformed, in its cell of development. The crown of the last molar (*m* 3) is also formed, and was about to pierce the gum. The permanent dentition of *Halmaturus ruficollis*, Gd. (*Kangurus ruficollis*, Dm., 1817), is that of *H. ualabatus*.

In *Macropus* (*Halmaturus*) *erubescens*, Scl.†, the premolar (Plate XX. figs. 1–8, *p* 3) has, in the upper jaw (fig. 1), nearly risen into place, the crown being extricated from the formative socket before the penultimate molar has appeared through the gum. The skull here figured gives an interesting phase of dental development. The premolar has displaced the second deciduous molar (*d* 3) on both sides of the upper jaw, *d* 2 continuing on the left side, and its socket being unobliterated on the right side. In the lower jaw (fig. 4) the premolar (*p* 3) has pushed half its crown above the socket on the left side, from which both *d* 2 and *d* 3 are displaced, whilst *d* 3 remains on the right side, the premolar

* Anat. of Vertebrates, vol. iii. fig. 296, E, *p* 3.

† Sclater, 'Proceedings of the Zoological Society,' March 7th, 1871, p. 240 (Cut, figs. 5 & 6). This eminent zoologist remarks:—"The muffle of *M. erubescens* is quite naked; and the species therefore belongs strictly to the section *Halmaturus* of Mr. Waterhouse's arrangement." But the bony palate is entire, as in most large Kangaroos, including *M. antilopinus*, *M. robustus*, and *M. rufus* "of the present convenient but, as it appears to me, arbitrary division" (Waterhouse, *op. cit.* p. 95).

not having come into view; a trace of the socket of the shed $d_2$ remains. In a younger individual of *Macropus erubescens*, the skull of which, marked "'*Uroo*,' far north," was kindly sent to me from Adelaide, South Australia, by G. F. WATERHOUSE, Esq., the three deciduous molars are in place and use (Plate XX. figs. 6 & 7, $d_2$, $d_3$, $d_4$); $m_1$ has nearly risen into place in the upper jaw (fig. 6), but is not so far advanced in the lower jaw (fig. 7). The germ of the premolar ($p_3$) is exposed by removal of bone in the upper jaw.

In the skull of a nearly full-grown Kangaroo (*Macropus* (*Boriogale*) *magnus*, Ow.), also from the "far north" of the province of South Australia, the premolar is represented by the foremost deciduous tooth. On the left side of the upper jaw it is in contact with $d_4$, and $m_3$ is nearly risen into place; on the right side (Plate XX. fig. 12) a vacuity corresponding with the hind half of $d_3$ remains, and shows the socket of the hind root of that deciduous tooth. Its homotype in the lower jaw (fig. 12 *a*) is shed in both rami, and the very small bilobed crown of $d_2$, or $p_3$, is in close contact with $d_4$. If $d_2$ had a predecessor, it must then be the tooth ($p_3$) which I suppose it to represent. In either case the modification is rare, and, so far as I know, unique in the bilophodont section of *Macropodidæ*: assuming the foremost tooth to be $d_2$, it repeats the condition and formula of the molar series in *Diprotodon* and *Nototherium*.

I shall not here carry further the account of the dental changes in living species of Kangaroos; but there are modifications of the grinding-surface and crown of the molar teeth which are useful in tracing out the affinities of extinct species.

The premolar, like the foremost deciduous molar, has an antero-posteriorly extended crown, with a more or less trenchant margin, supported by two roots. The margin may be slightly thickened and obtuse posteriorly, with a still more feeble swelling anteriorly, and the crown may not show any other modification; such is the very small lower premolar of *Macropus* (*Osphranter*) *robustus*, Gd. (Plate XX. fig. 13, $p_3$). In the upper jaw of this species the premolar (fig. 14′, *a*, *b*), with an increase in antero-posterior and transverse extent, shows none in the vertical direction; but the thickened fore part of the crown is divided by a notch from the rest of the trenchant border, and this by a smaller notch from the hind swellings; moreover the base of the crown is produced inward, and this ridge swells out posteriorly. The fore-and-aft dimension of the upper premolar does not, however, exceed that of the adjoining molar, $d_4$.

In *Macropus* (*Boriogale*) *magnus* (fig. 12) the upper premolar, or its representative, is not so long from before backward as the adjoining two-ridged molar. The anterior thickening is not marked off by a notch; it is connected by a basal rising with the hinder thickening, and the intermediate rather depressed outer surface shows two faint vertical ridges. An inner basal ridge swells into a small tubercle posteriorly.

In the lower jaw (fig. 12 *a*) the still smaller homotype has the crown transversely cleft to its base, and the hinder, somewhat larger lobe is thickest behind, with a feeble internal tubercle.

The upper premolar of *Macropus erubescens* (ib. figs. 1 & 2, $p_3$) is similarly cleft,

though not quite to the base; it has an inner basal ridge swelling behind into a tubercle, which abuts upon the hinder and larger division of the cleft crown. The lower premolar, of smaller size (figs. 4 & 5, $p_3$), is cleft in a minor degree.

In *Macropus ualabatus* the premolar exceeds the adjoining molar ($d_4$) in antero-posterior extent. In the upper jaw the trenchant border is slightly notched by a few vertical grooves traversing the outer side of the crown; and the inner basal ridge is similarly but more deeply notched; the entire crown is also broader than in the premolars of the previously cited species.

The modifications of the crown in the transversely two-ridged or "bilophodont" molars add characters in the discrimination of fossils, and it is convenient to define and name the parts affording them. The main "lobes" (Plate XX. figs. 29, 30, & Plate XXI. fig. 13, $m_3$) are "front" ($a$) and "back" ($b$); a ridge along the fore part of the base of the crown is "prebasal" ($f$); if, as is usual, there be one at the back part of the crown it is "postbasal" ($g$, ib. fig. 29, & ib. figs. 12 & 15, $m_3$). Commonly these several transverse elevations are connected together by ridges which affect a longitudinal course: that which ties the prebasal ridge to the front lobe is the "fore link" (ib. fig. 29, & ib. fig. 13, $m_3$, $s$), that which ties together the main lobes is the "mid link" ($r$), that which descends to the "postbasal" ridge is the "hind link" ($t$), of which ridge it frequently seems to be the sole representative (Plate XXI. fig. 18, $t$).

The upper molars, as usual, are broader than the lower ones, and the prebasal ridge is usually narrower (antero-posteriorly); but the ridge descending from the hinder and inner angle of the back lobe to the base of the hind surface of that lobe ("hind link" and "postbasal ridge") is usually better marked or more commonly present in the upper than in the lower molars.

The coronal modifications of these teeth are represented in certain existing species in figs. 23 to 28, Plate XX.; to these are added figures of a lower molar in two of the extinct species of Kangaroo (ib. figs. 29, 30), which I next proceed to define.

§ 2. *Macropus Titan*, Ow.—This species was founded on a portion of the right ramus of a lower jaw from the Breccia-cave in Wellington Valley, New South Wales; in which jaw, notwithstanding the superiority of size of the molar and of the portion of molar in place to any of those in *Macropus major*, I was led from certain indications of immaturity to ask permission from the possessor and discoverer of the then (1836) unique fossil to excavate the substance of the bone; this being granted, led to the detection of the nearly complete premolar or successional tooth in its formative alveolus, such as is figured in vol. ii. pl. 29. fig. 3 of Sir THOMAS MITCHELL'S work*.

The discovery of the premolar was a satisfactory addition to the less conspicuous differences in the molars of the present as compared with those in the fossil jaw of a similarly sized extinct Kangaroo, also in Sir THOMAS MITCHELL'S collection, on account of the remarkably large and complex character of the premolar in that fossil, now the

* Three Expeditions into the Interior of Eastern Australia, &c. 8vo. 1838, vol. ii. p. 360 (2nd edit. 1839, p. 366, pl. xlvii.).

type of *Sthenurus* (*Macropus*) *Atlas* (comp. fig. 18, $p_3$ with fig. 4, $p_3$, Plate XXII.). But I had not at that time the further satisfaction of determining the characters of the maxillary dentition of *Macropus Titan* by fossils of that species, either at the corresponding immature stage of the animal affording the mandibular fragment or of full-grown individuals. I have subsequently received both desiderata, some of which reached me in time to notice in the under-cited work*, and of which figures are now for the first time given. The maxillary specimen (Plate XXI. figs. 6–9), in its phase of dentition, relates as closely to the mandibular one (Plate XXII. figs. 17, 18) as does the upper jaw of *Sthenurus Atlas* (Plate XXIV. figs. 4 & 5) to the portion of lower jaw (Plate XXII. figs. 3 & 4).

The fossil in question (Plate XXI. figs. 6–9) is not from the Breccia-cave of Wellington Valley, but from a freshwater bed or drift in Queensland, where it was obtained and transmitted to me by my friend George Bennett, M.D., F.L.S. This is interesting as evidence of the range of the large and now extinct species. It shows the usual state of petrifaction of fossils from that formation and locality. It is a portion of the left maxillary bone, with a series of five molars *in situ*. The first (ib. ib. $d_2$), slightly mutilated externally, has a simple subcompressed unilobate (or subbilobate ?) crown, broadest behind, of much smaller size than that of the following two-ridged grinder ($d_3$); its working-surface had been worn so as to expose a broad field of dentine. The next tooth ($d_3$) shows a minor degree of abrasion, the third molar ($d_4$) still less. In the fourth ($m_1$) the summits of the two transverse ridges have just been touched; those of the hindmost molar ($m_2$) in place had not come into use, although they attained nearly the level of the ridges of the antecedent tooth. Moreover, behind the fifth molar was the fore part of a smooth subspherical cavity (ib. fig. 9), plainly the formative alveolus of another molar ($m_3$) still to come into place.

Accordingly the five molar teeth in this maxillary fossil I interpreted as homotypal in the upper jaw with the five molars in the lower jaw of a similarly immature *Macropus major*. Adopting the symbols in fig. 296, D, vol. iii. of my 'Anatomy of Vertebrates,' those of the five teeth in the present fossil would be:—$d_2$, $d_3$, $d_4$, $m_1$, & $m_2$. To test this conclusion I proceeded to remove the outer table of the jaw-bone above $d_3$, and detected the germ of $p_3$ (ib. fig. 6), in a stage of development like that of $p_3$ in the lower jaw of the type specimen (Plate XXII. fig. 18), and corresponding with the state of the dentition in the upper jaw of *Macropus erubescens* (Plate XX. fig. 6). The back tooth, when formed in the hindmost closed alveolus, would be $m_3$, completing the total of seven teeth developed in the molar series of the *Macropodidæ*.

In the upper premolar of *Macropus Titan* the crown consists of two simple, conical, subcompressed lobes, the hindmost being thickest posteriorly; it is supported on two roots, the formation of which had commenced in the specimen described: its movement into place, or into the masticatory series, would have involved the shedding of $d_2$ and

* Catalogue of the Fossil Mammalia and Birds in the Museum of the Royal College of Surgeons, 4to, 1845, p. 324, Nos. 1500 and 1510.

$d_3$; its crown would then contrast with that of $d_4$ by its freshness or freedom from wear. The convexity of the outer surface of the two lobes, and the depth of the dividing indent, accord with the characters of the lower premolar of the type specimen of *Macropus Titan* expressed in fig. 18, Plate XXII.

The bilophodont* upper molars of *Macropus Titan* (Plate XXI. fig. 8) show a well-developed "prebasal ridge" connected by a "link" of enamel with the fore part of the front lobe, near the middle and inclining rather toward the inner angle. In *Sthenurus Atlas* (Plate XXIV. fig. 6) this link is feebly if at all developed.

The mid link connecting the two main lobes in *Macropus Titan* (Plate XXII. fig. 11) is rather sinuous and tumid; it is better developed in this species than in *Sthenurus Atlas* (Plate XXIV. fig. 6). The oblique posterior ridge (Plate XXII. fig. 11, $m_3$, $g$, and Plate XXI. fig. 9, $m_2$) is strongly marked, and defines a depression at the inner and under side. The main lobes have broad convex bases in the side view of the molars, and the entire crown is longer in proportion to its transverse breadth than in *Sthenurus Atlas*.

The front pier of the zygomatic arch (Plate XXI. fig. 6, $21'$) is in advance of the hindmost molar in place ($m_2$) in this young specimen. The anterior outlet of the suborbital canal (ib. fig. 6, $21$) is 9 lines in advance of the orbit. Behind the outlet ($21$) is the small orifice ($a$) of a (vascular ?) canal, descending into the substance of the maxilla. I have not observed this orifice in the large existing Kangaroos. So much of the bony palate as is preserved (ib. fig. 8) is entire aud imperforate, as in *Macropus major*. This character, associated with the small size and simple structure of the premolar, and, as will be seen in subsequently described fossils, its comparatively early loss, support a reference of the present large Kangaroo to the genus *Macropus*, as restricted by most zoologists of the present day.

In the specimen from the Breccia-cave, Wellington Valley, of the left upper maxilla and molar series (Plate XXI. fig. 10) the premolar had risen into place; the last molar ($m_3$) was protruding from the formative cell, but had not come "into line;" the first two deciduous molars had been shed.

The crown of the foremost tooth was broken off, but the fangs remained (ib. $p_3$). They were two in number (the hindmost the largest), corresponding in relative size, degree of divarication, and extent of jaw occupied by their insertion with those developed in the unprotruded premolar of the younger specimen (ib. fig. 6, $p_3$). The choice of the tooth belonging to the fangs in front of the series in the subject of fig. 10 lies between $p_3$ and $d_3$; but the latter tooth has, in conformity with its broader bilophodont crown, four roots, each pair diverging from a transversely extended base. The evidence of the roots remaining in the socket of the broken molar is therefore decisive of its homology; the loss of the crown of $p_3$ is nevertheless regrettable. Its working-surface would have contrasted with that of the tooth $d_4$, which, having been longer in place and use,

* This term signifies not only that the crown is composed of two principal ridges or lobes, but that these are transverse in position.

shows each transverse lobe worn to near its base, exposing corresponding broad tracts of dentine united by a linear strip along the base of the mid link. In $m_1$ the dentine exposed on the transverse lobes is a linear tract, rather broader on the front lobe; the front ($s$) and mid ($r$) links show abrasion, but not carried to the exposure of the dentine. In $m_2$ the enamelled summits of the ridges are slightly abraded; $m_3$, as before stated, had not risen into place.

The molar characteristics of the species (*Macropus Titan*) are well exemplified in this cave-specimen. Sufficient of the palate is preserved to show, as in the preceding one, that it had no large vacuities. The relative position of the zygomatic pier (21) seems to have retrograded as compared with fig. 8; but it still strengthens the jaw where the hindmost molar here ($m_2$) was in use; when $m_3$ comes into place and takes its share, the jaw, as we shall see again, becomes concomitantly modified.

The specimen described and figured formed part of the collection of duplicate fossils obtained, under the favourable circumstances detailed in the Philosophical Transactions for 1870, p. 569, by Professor THOMSON and Mr. KREFFT from the Breccia-cavern discovered by Sir THOMAS L. MITCHELL, C.B.

In a collection of marsupial fossils at Worcester I recognized a portion of the right upper jaw, with the molar series, of a *Macropus Titan* exemplifying the stage of dentition when the last molar as well as the premolar had come into place, but the former so recently that the zygomatic pier had not much receded in position. The first and second deciduous molars ($d_2$ and $d_3$) had been shed. The part of the series $d_4$ to $m_2$ inclusive occupied a space rather short of that containing the homologous teeth in the younger specimen (Plate XXI. fig. 10); but the structure of the last two teeth and the proportions of the premolar were those of *Macropus Titan*. Unfortunately the crowns of the first three teeth had suffered fracture. A portion of the hinder fold of enamel remained on the broken base of the crown of the premolar, showing that the hind lobe of that tooth, besides being thicker than the fore one, was divided into an outer and inner lobule. Its longitudinal extent agreed with the crown of the germ of $p_3$ exposed in the subject of fig. 6, Plate XXI.

The same phase of dentition is exemplified in a similar portion of the right maxillary of another and somewhat larger individual of *Macropus Titan* (Plate XXI. fig. 11), in which the crown of the premolar is entire, and shows by its unworn condition that it had but recently risen into place. This tooth instructively contrasts with the next grinder, which is worn down so as to expose a continuous field of dentine, encroached upon by two opposite folds of enamel from the inner and outer sides of the crown meeting at the middle. In the next tooth the dentine is exposed upon each of the transverse lobes and upon part of the anterior "link." In the penultimate molar a thin line of dentine appears on the front lobe, but the enamel is not worn down so far in the hind lobe. The enamel ridge of the front lobe of the last molar is touched by abrasion. The crown of the premolar shows it to have been the last of the series of five teeth now come into place. It is trilobed: externally it shows only the bilobed structure (as in fig. 6);

but there is a smaller third tubercle on the inner side of the hind lobe, increasing the breadth of that part of the tooth, as was indicated by the last-described specimen (ib. fig. 10, *p* 3). The length of the entire series of five teeth is 2 inches 9 lines; that of the premolar (fore-and-aft diameter of crown) is 5 lines, that of the next tooth (*d* 4) being the same; that of the penultimate molar is 8 lines. The whole series is bounded on the inner side by an almost straight, very feebly concave line; the outer contour is rather more convex.

The two specimens above described are in the Museum of the Natural-History Society of Worcester, to the Council of which I am indebted for the opportunity of describing and figuring them. They were obtained by the donor, HENRY HUGHES, Esq., in the freshwater deposits of Darling Downs.

The subject of figs. 15, 16, & 17, Plate XXI., is also from the freshwater deposits of Queensland. It includes a considerable proportion of the right maxillary, with the last four grinders *in situ*, the dentine being exposed along a very narrow strip of the front lobe of the hindmost tooth (*m* 3). In the foremost (*d* 4) the channel of dentine along the mid link is not quite exposed, the enamel at the base of the link still remaining. The two anterior deciduous molars and the premolar have been shed and the alveoli obliterated. This, therefore, is from a fully mature individual. The three teeth (*d* 4, *m* 1, *m* 2) homologous with the last three molars of the young specimen (ib. figs. 6–8) occupy the same longitudinal extent, viz. 1 inch 8½ lines: with the fully developed succeeding teeth they exemplify the later stage of the upper molar dentition in the present extinct species. The last molar (ib. figs. 15 & 16, *m* 3) shows well the characteristic modifications of its working-surface in *Macropus Titan* as compared with that in *Sthenurus Atlas* (Plate XXIV. fig. 6, *m* 3): the prebasal ridge (*f*) is broader; its margin rises (the tooth being viewed prone) from the outer end to near the middle of its transverse course, then sinks more rapidly to its inner end, which bends up upon the front lobe. From the low or open angle thus described by the sharp margin of the prebasal ridge, the linking process (*s*) extends to near the middle of the fore part of the front lobe. In *Sthenurus Atlas* there is no front link; the margin of the narrower and lower prebasal ridge forms no angle as it sinks to terminate at the fore and inner end of the front lobe.

The mid link (Plate XXI. fig. 15, *m* 3, *r*) comes off from the front lobe nearer to its inner end in *Macropus Titan*, but not from that end as in *Sthenurus Atlas* (Plate XXIV. fig. 6, *m* 3, *r*). It is more developed in *Macropus Titan*, and its course is more longitudinal as it recedes to abut against the middle of the hind lobe; the postbasal ridge (*g*) extends from the postinternal angle of the hind lobe downward and outward to the postexternal part of the base of that lobe, leaving a well-marked oblique dent or cavity on the posterior surface of that lobe. In *Sthenurus Atlas* a general slight concavity of the hind surface of the hind lobe of *m* 3, upper jaw, is bounded below by a feeble postbasal ridge. With an equality of breadth, the fore-and-aft extent of the last molar in *Macropus Titan* exceeds that of *Sthenurus Atlas* by 1 line.

The hind border of the front or maxillary pier of the zygomatic arch is on the vertical

parallel of the interval between the fore and hind lobes of $m_3$ (Plate XXI. fig. 15). The retrogression of this buttress of bone is concomitant with the grinding-function now assumed by the last of the molar series (compare with figs. 10 & 8).

The anterior outlet of the suborbital canal (Plate XXI. fig. 16, $_{21}$) is 1 inch in advance of the anterior border of the orbit. Three lines behind the antorbital foramen is the smaller oblique aperture (*a*) leading down to the interior of the maxillary bone. The outer plate of the maxillary, in advance of and below the antorbital foramen, shows a depression; while the maxillary wall of the nasal cavity swells outward in existing Kangaroos. The proportion of the bony palate preserved shows the small narrow fissure where the maxillo-palatine suture bends inward opposite the fore part of $m_3$; elsewhere the palate is entire, as in *Macropus* proper, in *Boriogale*, and *Osphranter*. The fore part of the palate near $d_4$ shows a longitudinal channel (ib. fig. 15, *b*), 4 lines broad, bounded anteriorly by a ridge, or hind part of the diastema, extending forward and inward from the fore part of the socket of $d_4$, where the sockets (here obliterated) of $p_3$ and $d_3$ had been. This prepalatal groove is not shown in *Macropus major*, *Macropus rufus*, or *Osphranter robustus*.

The maxillary bone extends for 10 lines behind the last molar, on the level of the alveolar openings, and is there impressed by the shallow groove leading to the foramen and canal between the back part of the maxillary and the pterygoid process of the alisphenoid. The figures (Plate XXI. figs. 15–18) being of the natural size preclude the need of verbally noting admeasurements.

The side view of a corresponding part of the upper jaw of a large male *Macropus rufus*, at the same stage of dentition as in the present fossil, is given in Plate XXIII. fig. 1; it is from one killed by Mr. Gould, and was the largest Kangaroo which he saw in Australia.

In reference to the constancy in size and other characters of *Macropus Titan*, I was fortunate in finding a second specimen from an adult of this fine extinct Kangaroo in the Geological Museum of the University of Oxford, which the learned and estimable Professor of Geology, John Phillips, D.C.L., F.R.S.*, liberally transmitted to me for comparison and delineation. It was accompanied by an almost entire lower jaw of the same species, at the same phase of dentition, and apparently of the same individual. Both had been obtained by Dr. Nicholson, of Sydney, New South Wales (now Sir Charles Nicholson, Bart.), from the freshwater deposits of Queensland.

The subject of figs. 10, 11, & 12, Plate XXII., is part of the left upper jaw with the last four molars ($d_4$–$m_3$) in place; $d_3$ and $p_3$ have been shed and their sockets obliterated. The crowns of the remaining teeth show different degrees of abrasion, the summits of the last molar being slightly worn, not so as to expose the dentine. This specimen, therefore, bespeaks a fully mature but not aged animal.

The bone includes the base of the anterior pier of the zygomatic arch (from which the dependent process has been broken away), part of the floor of the orbit with the orbital

* His friends and science have to lament an irreparable loss since this was written.

aperture of the antorbital canal, and a considerable extent of the bony palate (showing the same imperforate structure as in the preceding specimens of *Macropus Titan*).

The pier of the zygoma extends obliquely from the under and fore part of the orbit downward and backward, the hind border being on the vertical parallel of the middle of the last molar. The ridge from the outer side of the masseteric process subsides, as it rises toward the orbit, sooner than in *Macropus major* or *Macropus laniger*. As in the last described specimen, the anterior outlet of the suborbital canal is relatively further in advance of the orbit than in *Macropus major*, being an inch from that part and on a vertical parallel with the diastema in advance of the front molar ($d_4$); in *Macropus major* it is above the interval between $d_4$ and $m_1$, and opens only $4\frac{1}{2}$ lines in advance of the orbit. In *Osphranter robustus*, Gd., the antorbital foramen is 10 lines in advance of the nearest part of the orbital margin, and is on the vertical parallel of $d_4$. It thus more nearly resembles *Macropus Titan* than does *Macropus major*; but the larger extinct Kangaroo differs from both the large existing species in the following structure, which I now have ground for regarding as constant. There is, as observed in former fossils of *Macropus Titan*, a foramen ($a$) 3 lines behind the antorbital one ($_{21}$), fig. 10; it is not another outlet of the suborbital canal, but leads obliquely downward into the entrance or substance of the maxillary bone. Of this foramen ($a$) I have not seen a trace in any existing Kangaroo, save *Macropus erubescens* (Plate XX. fig. 1, $a$). The degree of attrition of the upper molars in fig. 11, Plate XXII., agrees with that of the lower molars in fig. 14, ib. The exposed tract of dentine in $d_4$ is continuous, the mid link being worn down to its base; the fore part of the crown is broken off. In $m_1$ the front lobe is worn down to the level of the prebasal ridge, which is well marked, overlies the back part of $d_4$, and shows a rudiment of a link or mid rising to the front lobe of its own tooth. The line of abrasion of this lobe is from without inward and a little backward, not transverse to the skull's axis: a mid link is continued from it to the middle of the front surface of the hind lobe; this is worn, but not so as to obliterate the oblique outer cleft dividing it from the postbasal ridge which rises to be lost in the inner end of the hind lobe.

In $m_2$ the characteristic configuration of the crown of the upper molar of *Macropus Titan* is well shown. The two chief lobes are more nearly transverse in the direction of their summits than in *Macropus major*; the prebasal ridge with its linking process and the mid link are as well marked as in that species, and the oblique postbasal ridge is longer. In the last upper molar of *Macropus Titan* this ridge ($g$), which is almost obsolete in *Macropus major*, is as well marked as in the preceding molar, $m_2$. The mid link of the last molar is more curved than that of $m_2$; the concavity of the curve is turned inward.

Compared with the molars of *Sthenurus Atlas* (Plate XXIV. fig. 6) the prebasal ridge is rather more developed, the mid link is thicker, the outer and inner sides of the transverse ridges are thicker and more prominent, and the fore-and-aft extent of the crown is relatively greater.

The crowns of the upper molars are, as usual, broader than those of the lower jaw, and, as in *Macropus major* and *Nototherium*, the last lower molar has a greater longitudinal extent of grinding-surface than the tooth above.

In another specimen of a smaller portion of the left maxillary of *Macropus Titan* in the University Museum of Geology, Oxford, the dentition is shown at the same phase of development as in the preceding fossil, with a rather greater degree of abrasion. A thin line of dentine is exposed upon the summit of the anterior lobe of $m_3$; the mid link is worn to its base, exposing a linear tract of dentine uniting the broader field upon the anterior and posterior lobes. The size and other characters of the upper molars in figs. 10–14 (Plate XXII.) are satisfactorily repeated in the present evidence of *Macropus Titan*.

Both specimens are from the freshwater beds or drifts of Queensland, and were presented to the Oxford Museum by Sir CHARLES NICHOLSON, Bart., M.D., and formerly Speaker of the Legislative Assembly at Sydney, New South Wales.

The portion of right upper maxillary (Plate XXIII. figs. 2 & 3) in which the adult series of five grinders had been acquired, but with posthumous mutilation of the crowns of the two anterior ones, shows a modification of those of the three following ($m_1$, $m_2$, $m_3$) which I now know to be a variety, although not such as to induce me to refer the fossil to another species. The mid link (fig. 3, *r*) as it passes forward from the hind to the front lobe expands and divides; the more direct or normal continuation, after reaching the front lobe, bends to terminate or be continued into the inner border of that lobe; the other lower and shorter division turns outward to be lost upon the lower part of the outer half of the hind surface of the front lobe.

This character I briefly expressed as "a more complex form of the longitudinal ridge connecting the two principal transverse eminences" than in *Macropus major* or *Macropus laniger*, in my 'Catalogue of the Fossil Mammals* in the Museum of the Royal College of Surgeons'; at the date of which work this specimen was the sole evidence of the upper jaw and teeth which appeared to me to be referrible to *Macropus Titan.*

Besides the structure of the grinding-surface of the molars above defined, those in fig. 3, Plate XXIII., are arranged with a curve rather more marked than in the subject of fig. 11, Plate XXII.; but as the teeth here are less straight than those in the subject of fig. 8, Plate XXI., this seems to be but a ground of variety. The relative position of the zygomatic pier in figs. 2 & 3, Plate XXIII., may relate to the recent movement of $m_3$ into its working position: the untouched lobes of this tooth are longer and sharper than usual; yet the general concordance with the molar characteristics of *Macropus Titan* lead me still to refer the specimen No. 1510 to that species.

The modification of the mid link seems a small matter, but is not so in the actual phase of zoology. Evolutionally speaking, this variety may be viewed as either a remnant or a dawn of a complex condition of the part which will be described in subjects of a subsequent section.

* 4to, 1845, p. 324, No. 1510.

Of the mandibular dentition of *Macropus Titan* an early stage is exemplified in the fragment of lower jaw from the Breccia-cave of Wellington Valley on which the species was founded*.

I have given an improved figure of the outer side of this specimen, with the premolar exposed in the primitive alveolus, in Plate XXII. fig. 18, and have added a view of the grinding-surface of the two mutilated molars *in situ* (ib. fig. 17). This portion of (right) mandible of *Macropus Titan* includes the hind part of the first molar ($d_4$) and a larger proportion of the succeeding molar ($m_1$). The anterior lobe of this tooth is entire; the hind part of the posterior lobe is broken away.

The anterior talon or "prebasal ridge" of $m_1$ has almost the character of a lobe; it is united to the anterior normal transverse lobe by a well-developed fore link, commencing near the outer angle of the fore lobe, and describing a slight bend in its forward course to expand upon the hind part of the "prebasal ridge" nearer its outer than its inner end. The projecting angle of the "link" is directed inward. The valley between the anterior lobe and the prebasal ridge is thus divided into two hollows, the inner one being the largest. The inner border of the prebasal ridge is sharp, and abuts against nearly the middle of the back part of the antecedent tooth ($d_4$). The outer border of the prebasal ridge is thicker than the inner one, less inclined inward, and projects freely a little external to the level of the hind lobe of $d_4$. The back part of this lobe is entire; it shows a submedian posterior vertical indent; there is no perceptible trace of basal ridge.

The mid link (fig. 17, Plate XXII.) repeats the characters of the fore link, save that it sinks lower to connect itself with the anterior lobe, leaving more of the summit of that lobe free than is left to the prebasal ridge. The summit of the anterior ridge of $m_1$ inclines a little forward as it crosses the tooth from without inward, and is slightly bent with the convexity backward. The mark of wear, which in the young animal owning this tooth had not exposed the dentine, affects the hinder slope of the summit of the transverse ridge.

The characters of the crown in the two lower grinding-teeth of the type specimen of *Macropus Titan* above described are, in the main, those of the largest existing representatives of the true or subgenerically restricted *Macropus*.

In the lower jaw of *Macropus major* (Plate XX. fig. 15) the prebasal ridge (fig. 16, *f*) of $m_1$ and $m_2$ has a like size and shape, and is connected with the anterior lobe by a similar link; but this is less bent inwardly in its forward course. In *Macropus rufus* the prebasal ridge is less developed (Plate XXI. fig. 4); there is no postbasal ridge or talon. A feeble vertical notch is shown by the back part of $m_1$ and $m_2$; this does not

* Three Expeditions, 8vo, 1838, by Sir THOMAS L. MITCHELL, C.B., vol. ii. p. 359, pl. xxix. fig. 3. This specimen, with other fossils from the Wellington Valley cavern, submitted by its discoverer to me, were presented to the Geological Society of London, to the President and Council of which I am indebted for the opportunity of reexamining and figuring this collection, which initiated our knowledge of the fossil Mammals of Australia.

appear in $m_3$. The proportion of length to breadth of the grinding-surface of the true molars is the same in the recent as in the extinct species compared; the difference is mainly in size.

In a portion of the right mandibular ramus of *Macropus Titan*, with the three posterior molars *in situ*, these, like the single entire molar in Plate XXII. fig. 17, $m_1$, show a proportionally greater antero-posterior extent of the prebasal ridge than in *Macropus major* or *Macropus* (*Osphranter*) *rufus*. Of the latter existing species* Mr. GOULD, F.R.S., was so good as to place in my hands, for the purpose of these comparisons, the jaws and teeth of a male which he killed between the rivers Murray and Adelaide, Australia; it measured 8 feet 2 inches from the nose to the end of the tail, and was the largest Kangaroo which that eminent naturalist saw in the continent of which he has so admirably illustrated the rich ornithology as well as its singular mammalogy.

These specimens I presented, in Mr. GOULD'S name, to the Royal College of Surgeons†, after their application to the requisite comparisons with the fossils from the Wellington Valley caves and freshwater beds of Australia. Figs. 1 & 14 in Plate XXIII. give a side view, and figs. 2 & 4, Plate XXI. the grinding-surface, of the right series of upper and lower molars of this animal, of the natural size.

So much of the mandibular ramus of a *Macropus Titan* (Plate XXII. figs. 13–16) as remains in the specimen in the Oxford Museum closely agrees, save in size, with that of *Macropus major* (Plate XX. fig. 15). As in that recent specimen, the individual affording the present fossilized relic had shed both the premolar and the two anterior milk-teeth; $d_4$ also shows a wear of crown and exposure of roots indicative of speedy expulsion. The long diastemal border (between $d_4$ and $i$) is trenchant to near the outlet of the incisive alveolus. It descends, more rapidly than in the living Kangaroo, from the anterior molar socket, with a concave curve, reducing the vertical extent of the symphysial part of the ramus at the outlet of the dental canal (ib. fig. 13, $v$) to two thirds of that at the outlet of the anterior molar socket, $d_4$. In advance of the dental canal the symphysial part of the jaw is reduced to a mere case of the root of the long procumbent incisor, $i$.

The descent is less sudden, and the concavity of the diastemal border somewhat less, in another specimen of the mandible of *Macropus Titan*, which more closely resembles in this respect the recent Kangaroo.

The symphysial surface in *Macropus Titan* (Plate XXII. fig. 15) begins behind, in advance of the vertical parallel of the fore part of the first molar socket; it expands so as to cover the lower half of the inner surface of the ramus at the part opposite the outlet ($v$), and then contracts to terminate before attaining the outlet of the incisive alveolus, at least as regards its grooving and other rough markings for ligamentous union. The contrast between this structure of the symphysial joint and that in fig. 6, $s$ (*Sthenurus Atlas*), is considerable, and supports the inference that the junction between

* Then known as the *Macropus laniger*.

† See 'Catalogue of the Fossil Mammals and Birds' &c., 4to, 1845, pp. 324, 325, Nos. 1510, 1511.

the right and left rami was not more close in the large *Macropus Titan* than in *Macropus major*. The direction of the elongated socket of the incisor and the procumbent position of that tooth in the fossil are as in the existing species of *Macropus*. The crown of the incisor, so far as it is preserved, agrees in shape, relative size, disposition of enamel, position and obliquity of the back part of the abraded working-surface, with that of *Macropus major*. The configuration of both outer and inner surfaces of the horizontal ramus, especially the ridge indicating the lower limit of insertion of the crotaphyte muscle and extending a little below the margin of the ectocrotaphyte cavity, as shown in *Macropus major* (Plate XX. fig. 15), are repeated in *Macropus Titan* (Plate XXII. fig. 13, *e*). The last molar stands out more freely, or entirely, in advance of the fore margin (ib. fig. 13, *q*) of the coronoid process in *Macropus Titan* than in *Macropus major* (Plate XX. fig. 15); and it advances further as the animal grows older and the molar series is further reduced.

The inflection of the inner and lower border of the ascending ramus begins anteriorly nearly in the same relative position. The anterior border of the intercommunicating vacuities (Plate XXII. fig. 15, *e*, *d*) between the outer and inner cavities of the ascending ramus appears to be the same in the present fossil as in the largest existing species of Kangaroo. The inner postalveolar border is smoothly rounded, and forms no angle indicative of a postalveolar process.

The molars in the fossil under description are more worn than in the *Macropus major* compared, with a similarly reduced series of teeth. In $d_4$ (Plate XXII. fig. 14) the exposed tract of dentine is continuous, the mid link crossing the valley being worn through. The prebasal ridge is indicated only by the internal notch; the basal remnant of the crown is supported by fangs, which are partially exposed by absorption of the alveolus, and the crown overhangs the beginning of the diastema, indicative of the impending fall of the tooth (ib. fig. 13, $d_4$); whence I infer that the molar dentition of *Macropus Titan* would be reduced in advanced age, like that in *Macropus major*, by the loss of $d_4$, and perhaps ultimately of $m_1$*.

The pattern of the working-surface of the succeeding molars closely accords with that in *Macropus* proper. The prebasal ridge is considerable, both longitudinally and transversely: the fore link is well marked; it joins the front lobe external to the mid line, leaving a fossa on each side. The contrast with the rudiment of this link in *Sthenurus Atlas* (ib. figs. 8 & 9) is considerable, as is that also in the development of the mid link and the breadth of the anterior margin of the prebasal ridge.

The antero-posterior breadth of the transverse ridges is greater in *Macropus Titan* than in *Sthenurus Atlas*, especially at their outer sides (comp. figs. 13 & 5); the longitudinal extent of the crown is relatively greater as compared with the transverse diameter in *Macropus Titan*.

In the next illustration of the mandibular characters of *Macropus Titan*, so much as is preserved of the two rami shows the angle at which they meet to unite at the sym-

* Since this passage was penned I have received from my friend Dr. BENNETT, F.L.S., evidence of the fact.

physis (Plate XXVI. fig. 9). It also shows that the comparatively loose union of the symphysis had permitted the right ramus to glide a little forward from the left one before they were fixed in position by the petrified matrix; but this correspondence with the large living Kangaroos is more decidedly shown in the subject of fig. 11, Plate XXVI. The right ramus of fig. 9 includes the last four molars, $d_4$, $m_1$, $m_2$, $m_3$, and a part of the premolar, $p_3$ (this tooth, like the crown of $m_1$, has suffered more from fracture than from masticatory action). The left ramus includes the last three molars and the hind half of the crown of $d_4$. The present fossil was obtained by HENRY HUGHES, Esq., in the freshwater deposits of Queensland, and is now in the Museum of the Natural-History Society of Worcester.

In a fossil with three molar teeth ($d_4$, $m_1$, and $m_2$), and the formative cavity of $m_3$, these teeth are somewhat inferior in size to their homologues in fig. 13, Plate XXII., and probably indicate that they come from the female of *Macropus Titan.* The subject of figs. 12 & 13, Plate XXIII., is the original specimen in the Museum of the Royal College of Surgeons, No. 1512*, which first afforded the characters of the penultimate and last molars of *Macropus Titan*: this I now believe to have come from a female of that species.

The mandible of *Macropus Titan* (Plate XXVI. figs. 11 & 12), after solution of the soft parts in its original burial-place, shows the effect of the disturbance of the grave by the dislocation of the rami, which had been somewhat loosely attached during life by the partial syndesmosis of the symphysis. So separated and shifted, the right ramus being pushed about 2 inches in advance of the left, the parts have rested without further disturbance long enough to permit the dislocated rami to become connected together by the petrified matrix. The bone, which during the same period had undergone some degree of petrifaction, appears again to have been subject to movements of the matrix, resulting in the amount of fracture of the most prominent parts which is common in the fossils from the freshwater beds of the Australian localities yielding the subjects of the present paper. But the later disturbances have not affected the artificial union of the previously separated and dislocated rami.

The jaw-bone in this specimen exceeds in depth and a little in length that of the *Macropus Titan* in the Oxford Museum (Plate XXII. figs. 13, 15), but the longitudinal extent of the four molars is the same. The present fossil is from an older individual: $d_4$ is worn down to its base, and the ridges of $m_3$ (both of the lobes and links) show more abrasion. The vertically oblong pit toward the inner side of the back part of the last molar (ib. fig. 15) is well marked. The symphysial articular surface (ib. fig. 12) is neatly defined behind; its rougher part subsides anteriorly, and ceases about an inch from the outlet of the incisive socket. The vertical diameter of this socket is 8 lines; that of the base of the incisor, where the tooth has been broken off, is 7 lines.

The portion of a left mandibular ramus of a fine old male of *Macropus Titan* (Plate XXVI. fig. 13) shows the largest size of the lower jaw which I have as yet seen in fossils

* Catalogue, *ut suprà*, p. 325.

of this species. But though the depth of the mandible at the interval between $d_4$ and $m_1$ is nearly half an inch greater than in the subject of fig. 11, or in the Oxford specimen (Plate XXII. figs. 13, 15), the teeth are not much larger. A figure of the working-surface of the last molar in this large *Macropus Titan* is given in fig. 14, and one of the hind surface of the same tooth in fig. 15, to exemplify the characteristic pit there in the fossil.

In the hind part of a mandibular ramus of a fine old *Macropus Titan*, with the last molar well worn, and now much in advance of the coronoid process, the depth of the jaw behind this tooth is 1 inch 6 lines, and the same at the interval between $m_2$ and the débris of the socket of $m_1$*.

§ 3. *Macropus affinis*, Ow.—In a small collection of Marsupial fossils made by Sir Thomas Mitchell, C.B., in a survey undertaken after his return to Australia in 1839, and which he was so good as to transmit to the Royal College of Surgeons, there were confirmatory evidences of the two large species represented by the fossils of his first collection in Wellington Valley, described and figured in his work published in 1838†, and also indications of a third species of large Kangaroo, which I described in my Catalogue of the Fossil Mammalia of the Museum of the College, and referred to a *Macropus affinis* ‡. This second collection was obtained, according to the notes accompanying it, "from the alluvial or newer tertiary deposits in the bed of the Condamine river, west of Moreton Bay."

The best evidence it contained of the *Macropus affinis* was a portion of the left mandibular ramus, now for the first time figured (Plate XXIII. figs. 10 & 11), including the antepenultimate and penultimate molars, and the sockets and fangs of the premolar ($p_3$) and of the first ($d_4$) and last ($m_3$) two-ridged molars. The two molars ($m_1$ and $m_2$) retaining their crowns showed the specimen to have come from an aged individual. The pattern of that of $m_1$ had been worn away, with mere indications of the two chief divisions and the prebasal ridge. The crown of the penultimate molar agreed in its general proportions more with that of *Macropus Atlas* than with that of *Macropus Titan*, but was narrower in proportion to its antero-posterior diameter than in *Macropus Atlas*, and the mid link was more developed. From its homologue in *Macropus Titan* the tooth differed in having no trace of a postbasal ridge (compare with fig. 13, Plate XXIII.). The depth of the jaw containing the teeth was greater than in *Macropus rufus* (of which a corresponding part of the mandible of a large individual is given in fig. 14, Plate XXIII.). The teeth, however, indicate a species of less size than either of the two extinct ones above cited. I therefore continue to regard this fossil as evidence of an extinct Kangaroo of intermediate proportions between the largest known living species and those defined in my original memoir, and of which additional illustrations are given in the present.

* This is the specimen alluded to as having been received, since the present paper was prepared, in the last collection of fossils from the freshwater deposits of Queensland, transmitted by George Bennett, M.D., F.L.S.

† Three Expeditions &c., 8vo, vol. ii. ‡ *Op. cit.* 4to, 1845, p. 328.

§ 4. *Osphranter Cooperi*, Ow.—The subject of figs. 17 & 18, Plate XXIV., is the fore part of the left mandibular ramus of an aged individual of a Wallaroo, of the size of *Osphranter robustus*. It retains the first three molars ($p_3$, $d_4$, $m_1$), the second of which, as having been longest in place, has the crown worn down to its base, from within obliquely outwards, and in a rather greater degree than in the corresponding tooth of the recent species compared, the mandible of which is the subject of fig. 13, Plate XX. The premolar ($p_3$) shows three small tubercles on its working-surface, arranged from before backward; the crown is subcompressed, and very slightly thickened behind; the inner surface of the fore part of the crown is gibbous, as in *Osphranter*, and its proportions are as in *Osphranter robustus*. The degree of wear of the next tooth is such as would be incompatible with the retention of the foremost if it were the deciduous tooth, $d_2$; but, for decisive evidence, I removed the inner wall of the ramus where the germ of $p_3$ would have been, and there was no trace of such successional tooth. The present fossil, therefore, has come from a fully mature individual. A species of true *Macropus* would not have retained the premolar or the following tooth at this age, or have kept $d_4$ with a crown so far worn down. Thus the fossil accords with *Osphranter* in the proportions of $p_3$ and $d_4$ and their long continuance in line with the following molars. The third tooth ($m_1$) in the fossil is relatively broader than in *Osphranter robustus*. The outer side of the diastemal and symphysial part of the mandible is less convex vertically than in *Osphranter robustus*. The symphysis begins behind in the same relative position to the premolar. I indicate the present fossil Kangaroo by the name of the donor, Sir DANIEL COOPER, Bart.; it was discovered in the freshwater beds of Darling Downs, Queensland.

§ 5. *Osphranter Gouldii*, Ow.—The subject of figs. 15 & 16, Plate XXIII., is a corresponding part of the lower jaw of a young specimen of the same subgenus, but of smaller size. The fossil shows a remnant of the socket of $d_2$, and the much-worn crown of $d_3$; that of $d_4$ is also much worn, but not reduced to the degree shown in fig. 18, Plate XXIV. To this smaller kind of fossil Wallaroo (*Osphranter Gouldii*) I have attached the name of the discoverer and founder of the genus.

§ 6. *Phascolagus altus*, Ow.—Of this species a portion of the upper jaw and teeth was figured in the Palæontological Appendix to MITCHELL'S 'Three Expeditions into the Interior of Eastern Australia,' &c., vol. ii. plate xxix. (plate xlvii. of 2nd edition) figs. 4 & 5, with the following remark:—"This specimen I believe to belong to *Macropus Titan*. The permanent false molar, which is concealed in the upper jaw, is larger than that of the lower jaw of *Macropus Titan*; but I have observed a similar discrepancy of size in the same teeth of an existing species of *Macropus*" (ib. p. 360). Subsequent and closer comparisons have, however, shown that the pattern of the grinding-surface of the upper molars is more like that in *Halmaturus* and *Osphranter* than in *Macropus major* or *Macropus Titan*; and the discovery of the upper jaw of the latter species at a corresponding phase of dentition (Plate XXI. fig. 6) has shown that, in size and simplicity of form, the upper premolar much more closely accords with the

lower one in the type mandible of *Macropus Titan* (Plate XXII. fig. 18) than does the premolar exposed in the specimen under examination (Plate XXII. fig. 1).

These phases of dentition, illustrative of the characters and affinities of the fossil under review, are shown in the specimens Nos. 1741, 1742, and 1743, in the Osteological Series of the Museum of the Royal College of Surgeons of England*, and are illustrated in Plate XX. figs. 1–12 of the present Paper. In the recent species (*Macropus* (*Phascolagus*) *erubescens*) the upper premolar (ib. fig. 6, $p_3$), in its form and proportions, still more closely resembles that (Plate XXII. fig. 1, $p_3$) of the larger extinct Kangaroo (*Phascolagus altus*) of the Wellington Valley Bone-cave.

This species combines with the proportion of the premolar, affording one of the characters of the subgenus *Halmaturus*, the entire or imperforate bony palate, which is found in all the species of *Macropus* in its restricted or subgeneric sense (Plate XXII. fig. 2). In this combination of characters the fossil agrees with the existing *Phascolagus erubescens*.

The degree of development of the concealed premolar, the crown being completed with the basal portions of both roots, coincides, as in *Phascolagus erubescens*, with the incompleted eruption of the molar ($m_1$) and the still hidden and undeveloped state of $m_2$ and $m_3$; whence may be inferred a like precocious appearance of the premolar in the working series, with the concomitant shedding of the two anterior deciduous teeth ($d_2$, $d_3$), the premolar preceding the penultimate molar in entering upon the work of mastication. The differences observable between the fossil and the recent Kangaroos combining the above characteristics of the proposed subgenus are, at least, specific.

The premolar, divided in both by a vertical cleft into a smaller anterior and a larger posterior lobe, shows in the fossil a more definite basal ridge along the outer side of the latter lobe than in *Phascolagus erubescens*; there is also a more definite outswelling of the hind part of the hind lobe in *Phascolagus altus*; two feeble grooves divide the outer surface of the fore part of the anterior lobe into three vertical prominences, but these are faintly marked in the present fossil.

In the bilophodont molars the prebasal ridge is narrow and the indication of the fore link is minute. The mid link is narrow, neatly defined, and sinks rapidly from the inner and posterior apex of the front lobe to the lower part of the interlobal valley. The postbasal ridge is represented by a similar outbending and descent of a sharp ridge from the inner angle of the hind lobe; which ridge, curving to subside upon the outer part of the base of the hind lobe, circumscribes, below, the depression or transverse concavity on the hind surface of that lobe.

The position and extent of the origin of the anterior pier of the zygoma is the same in the fossil and the recent species compared. The configuration of the hind margin of the bony palate is the same. But our extinct Kangaroo shows these characters of its subgenus on a larger scale than the largest known existing species of *Phascolagus*. The tooth $d_4$ (Plate XXII. fig. 2) is as large as its homologue in *Macropus major*; the

* Osteological Catalogue, 4to, 1853, p. 324.

antero-posterior extent of $m_1$ is a trifle more in the fossil. We may infer from the superior size, both absolute and relative, of the premolar in *Phascolagus altus* that the permanent molar dentition would be represented for a longer period of life by the five teeth, $p_3$, $d_4$, $m_1$, $m_2$, and $m_3$, than in the existing Great Kangaroo (*Macropus major*).

The specimen above described, with the rest of Sir THOMAS L. MITCHELL's first collection of cave-fossils from Wellington Valley, is in the Museum of the Geological Society of London. I am indebted to the President and Council for the opportunity of giving new and better figures of the type of *Phascolagus altus* than the original ones in the 'Appendix' of the above-cited work.

In the collection of fossils from the freshwater deposits of Queensland, lately received from Dr. GEORGE BENNETT, F.L.S., of Sydney, New South Wales, there are instructive evidences of *Phascolagus altus* adding to our knowledge of its cranial and dental characters. The specimen No. 38752, Register of Fossils, British Museum, is part of a right maxillary of a young animal with the dentition in nearly the same state as the subject of figs. 1 & 2, Plate XXII. The germ of the premolar seems rather less than in that type specimen; but the hind angle was broken off in the work of exposure, which the state of petrifaction of the lacustrine fossils made more difficult than in the Cave specimen. The fore link is a little more marked in $m_2$ than in the type specimen, but the agreement in other characters is sufficiently close to determine the species and subgenus as above defined.

The next Bennettian specimen is from a somewhat older individual of *Phascolagus altus*; it is a portion of the right maxilla with $d_4$, $m_1$, and $m_2$ in place; these three molars occupy the same extent as that in the skull of *Boriogale magnus*, the upper molars of which are figured in Plate XX. fig. 12—an extent about 1 line short of that in *Macropus rufus* (Plate XXIII. fig. 1), and about 1 line more than that in *Osphranter robustus* (fig. 3, Plate XXI.). We have here, therefore, plainly demonstrated, the representative of a Kangaroo about the size of the largest now living in Australia. Independently of the premolar character shown in the previous specimens, the present fossil could not be referred to *Macropus major*. The antorbital foramen is too remote from the orbit and from the ridged beginning of the masseteric process, which also is more directly continued from the fore border of the orbit than it is in *Macropus major*. The foramen in question is 7 lines in advance of the nearest part of the masseteric ridge in the fossil; it is $3\frac{1}{2}$ lines in advance of that ridge in *Macropus major*.

In the position of the antorbital foramen the fossil more resembles *Osphranter robustus*, in which, however, the foramen is about a line further in advance of the masseteric ridge; this, in its prominence, sharpness, and the depression anterior to it, resembles more than does *Macropus major* the fossil fragment compared. *Boriogale* more closely repeats the above-defined cranial character in the fossil. But *Phascolagus* has the palate entire, where *Boriogale* shows the large vacuity (Plate XX. fig. 12) common to it with the type species of *Halmaturus*, F. Cuv. In the molars of *Phasco-*

*lagus* the prebasal ridge is larger than in *Boriogale*; the breadth of the outer sides of the two main lobes is greater; the postbasal ridge better defines the hinder depression below.

Both the cranial and dental characters of *Phascolagus* forbid its reference to a *Boriogale*. In the upper molars of *Osphranter*, with a prebasal ridge developed in the same degree as in *Phascolagus*, the fore link is also present, though feeble; yet in a more conspicuous degree than in *Phascolagus*, where it can hardly be said to exist: the fore link is better developed in the upper molars of *Macropus major*, and the valley is wider between the two lobes.

The remains of the alveolar cavities for the two roots of the premolar show that it had come into place in the fossil under review; and the fore-and-aft extent which the two cavities occupy with the width of the intervening tract of bone indicate a premolar about the size, in that dimension, of that of the type specimen (Plate XXII. fig. 1, $p_3$), and rather longer than the following tooth ($d_4$), but far short of the proportions which characterize $p_3$ in the genera *Sthenurus* and *Protemnodon*, next to be defined. The state of the socket of $m_3$ in the Bennettian specimen, and the rising of its base between the insertions of the fore and hind fangs, clearly bespeak that this tooth had likewise come into place, and that the fossil under comparison is from a nearly mature individual of its kind. Sufficient of the bony palate remains to show (as in the younger type specimen) that it was entire, as in *Macropus* proper and *Osphranter*.

The interorbital aperture of the suborbital canal in *Phascolagus* is single, subcircular, and well defined; its fore and upper border rises upon a ridge or plate of bone, which extends forward and outward to near where the masseteric ridge subsides into, or rises from, the fore border of the orbit. This structure I have not observed in the skull of any existing species of *Macropus*, *Osphranter*, or *Halmaturus*; the nearest approach to it is seen in the skull of *Boriogale magnus*.

A second and larger proportion of the upper jaw of *Phascolagus altus* in the Bennettian series shows, on the left side, the base part of the crown of the premolar in place, and the sharp summits of the lobes of the last molar emerging from their nursery. The antecedent molars show more wear than in the preceding specimen. The mid link in $d_4$, in the present, is worn down to the dentine; yet the second lobe of $m_2$ is less abraded, and the fore link is rather more conspicuous.

On the right side the hind molar and its socket have been broken away. More of the premolar is preserved, but the bilobate outer part of the crown is wanting; it had, plainly, the antero-posterior dimensions of the entire crown exposed in the type specimen (Plate XXII. fig. 1). The tract of the suborbital canal is exposed in both halves of this upper jaw; and we see that its anterior outlet must be far in advance of the orbit, and about half an inch above the fore end of the premolar.

The molar series in this fossil equal in extent and in the size of the teeth those of *Macropus rufus* and *Macropus major*; they rather exceed in size those in the younger, perhaps female, individuals represented by the first-described fossil from the freshwater beds of Queensland and by the type specimen of *Phascolagus altus*.

§ 7. *Sthenurus Atlas.*—Similar considerations to those which influenced judgment and action in regard to the type fossil of *Macropus Titan*, added to plainer indications of the incomplete development of the rear teeth of the molar series in the fragment under scrutiny, led me, in 1837, to perform the same operation on the subject of fig. 4, Plate XXII.*; and great was my surprise at the result.

The hidden germ ($p_3$) equalled in antero-posterior diameter both the deciduous molars which it would have displaced, and surpassed in that diameter the largest of the molars to the extent of one half that length of their crown. For the great extinct species of Kangaroo so indicated I proposed the name of *Macropus Atlas*†.

The tooth so discovered recalled a dental characteristic of the Potoroos, or Kangaroo-rats (*Hypsyprymnus*, &c); but the molars in the fossil were strictly bilophodont, more so, indeed, than in *Macropus Titan* or the existing *Macropus major*. There was less indication, for example, in the "links" of any subdivision or reduction of the two transverse ridges to a quadrituberculate grinding-surface; they stood out more definitely and more freely. Moreover, the large premolar of the fossil was primarily divided externally into a fore lobe and hind lobe by a vertical fissure continued as a groove almost to the base of the crown, whilst the oblique extension of that fissure inward and backward gave a transversely subbilobed character to the unworn surface of the hinder part of the tooth. As, however, I have since obtained a portion of the upper jaw with the right series of molars of the same species, I will proceed with its description before entering upon further and requisite details of the mandibular evidences originally indicating the present extinct subgenus of Kangaroo.

The instructive illustration of the maxillary dentition of *Sthenurus Atlas* (Plate XXIV. figs. 4, 5, 6) formed part of a collection of fossils sent to me by F. G. WATERHOUSE, Esq., Cor.M.Z.S., Curator of the Museum of Natural History in Adelaide, South Australia, in the freshwater deposits of which province this fossil was obtained.

The portion of maxilla includes the masseteric process (ib. fig. 4, $21'$), the hind border of the maxillary pier from which it is continued being parallel to the interval between the penultimate ($m_2$) and last ($m_3$) molars. The process extends down a little below the alveolar border of $m_2$, and appears to be entire with an obtuse end. It is not so long relatively, does not reach so low, as in *Macropus major* or *Macropus* (*Osphranter*) *robustus*, but is more produced than in *Macropus* (*Halmaturus*) *ualabatus*: its proportions are most nearly those of *Macropus* (*Phascolagus*) *erubescens*. The outer surface of the base of the process is less deeply excavated than in any of the above-named recent species.

The convex tract behind the masseteric process and maxillary pier of the zygoma leads into the orbit, and there, about 8 lines in advance of the hind border of the pier, is the orbital aperture of the suborbital canal. It is single, subcircular, well defined, without any appearance of the oblong depression we there see in *Macropus*, *Osphranter*, and *Halmaturus*, where a second large foramen also communicates with the orbit.

* Plate xxix. fig. 1, MITCHELL'S 'Three Expeditions,' &c., vol. ii. 1838. † Ibid. p. 359.

The floor of the orbit presents an oblong depression (the "entorbital fossa"), with a sharp anterior and superior margin. From the fore part of this depression proceeds the suborbital canal, commencing by a large circular hole ("entorbital foramen"); a little way behind this is a smaller ("spheno-palatine") foramen.

The inner wall of the orbit, formed by the maxillary and palatine, curves outward and upward from the upper border of the depression to unite with that in advance contributed by the lacrymal, leaving the outer circumference of the entorbital foramen free from any direct rise of the interorbital plate. Anterior to the entorbital canal there is a more shallow and imperforate depression affecting the lower part of the lacrymal, at a little distance from the anterior border of the orbit. This structure of the orbital surface agrees with that in *Macropus* and *Osphranter*, with minor differences.

In *Macropus major* the entorbital fossa is deeper, the sharp upper border being extended backward beyond the spheno-palatine foramen; there is a third smaller "pterygo-palatine" foramen at the end of that border; but the fractured state of the fossil prevents the determination of its agreement or otherwise in regard to that third foramen.

In *Osphranter robustus* the second foramen is as large as the first, and is situated to its inner side and very little posterior to it, the intervening bony plate with a sharp concave edge forming the inner border of the entorbital foramen and the antero-external border of the more oblique spheno-palatine foramen.

In *Sthenurus Atlas* the upper border of the entorbital fossa, in its shortness and degree of sharpness, is more like that in *Macropus Titan*. The inner wall of the orbit ascends rather more directly therefrom than in *Macropus major*. The pterygo-palatine foramen in the palatine part of the inner orbital wall is more minute in *Osphranter* than in *Macropus*. In *Phascolagus erubescens* the proximity of the first and second foramina is closer than in *Osphranter*.

In the unique skull of *Boriogale magnus* it appears that part of the inner wall of the orbit completing, above, the circumference of the second foramen is unossified; and such part of the skull in a petrified state would show only one large circular orifice, answering to the first or entorbital one in *Macropus major* and *Macropus Titan*. In the comparison of the orbital part of the skull, *Macropus Titan*, in the relative size and position of the two anterior foramina (entorbital and spheno-palatine), agrees with *Macropus major* more closely than with the above-cited representatives of other subgenera of living Kangaroos.

From the upper and anterior margin of the entorbital foramen (Plate XXIV. fig. 5, *o*) rises a plate of bone (*n*, figs. 4 & 5), quickly narrowing to form part of the inner wall of the orbit, or partition-wall between that cavity and the nasal one. This structure implies a less relative depth, or diameter, of the orbit from without inward or transversely than in the existing genera above cited*. But a nearer approach to the above-defined orbital

* Whence may be inferred a smaller eyeball, associated perhaps with more diurnal habits, than in the still living Kangaroos.

character in *Phascolagus* and *Sthenurus* appears in *Boriogale*, where the nerves and vessels, passing by the floor of the orbit to the maxilla, leave only one mark of perforation of that floor by a subcircular entry to the canal, the other elements forming the second and contiguous foramen in *Macropus*, &c., here traversing the above-surmised membranous or unossified state of the inner and under wall of the orbit. The reduced ossified part continued from above the bony canal rises somewhat like the lamellate process shown at *n*, figs. 4 & 5, in *Sthenurus*. *Boriogale* also shows the longitudinal depression above and exterior to the entorbital foramen, terminating anteriorly in a blind end, as is seen in *Sthenurus* and in a feebler degree in *Halmaturus*.

The outlet of the suborbital canal in *Sthenurus Atlas* is relatively further from the orbit than in *Macropus major*, in which respect the present fossil resembles *Osphranter* and *Halmaturus*: the distance in the present example of *Sthenurus Atlas* is 1 inch 1 line. The lower part only of the outlet and canal is preserved in the present specimen; and below the outlet is a second small foramen, the canal from which passes backward, not downward as in *Macropus Titan*.

There is not sufficient of the bony palate preserved to determine whether it was as entire as in the larger living Kangaroos (*Macropus major*, *Osphranter robustus*, *Phascolagus erubescens*), or with vacuities, as in most species of *Halmaturus*; but part of the border opposite the interval between $d_4$ and $m_1$ (Plate XXIV. fig. 6) is so smoothly rounded off as to suggest that it is a natural, not a broken, tract.

The premolar has the middle two fourths of its outer surface slightly depressed and feebly concave lengthwise (ib. figs. 4 & 6, *a*), with two chief vertical ridges and others faintly indicated. The fore and hind ends of the outer surface are smooth and convex, or bulging; the free margin is subtrenchant, with the ends of the terminal bulges obtuse. The inner surface or division of the crown (ib. fig. 5, *b*) is much lower than the outer one, yet having more of the character of a part of the crown than of a developed "cingulum;" it increases in height as it recedes, the hind part swelling into an inner lobe, continued at the back part of the crown into the postexternal tubercle and abutting against the inner side of that part by a second transverse ridge. The lower and less developed fore part of the inner division of the crown is similarly connected with the antexternal tubercle, viz. by a low ridge forming the fore part of the crown, and by a buttress-like production against the inner surface of that tubercle. The intermediate part of the inner division is connected with the outer division by three transverse ridges (ib. fig. 6, $p_3$). A premolar of the size shown in the figures, and with the structure above described, would be held, according to its proportions to the molars behind, as indicative of a subgeneric section of *Macropodidæ*, for which I propose the term *Sthenurus*, suggested by the form and proportions of a vertebra of the very powerful tail of this great extinct Kangaroo*. I shall presently be able to show that the modifications of the mandible and mandibular incisor support this distinction.

The bilophodont upper molars of *Sthenurus* are characterized by a narrow prebasal

* Gr. σθένος, strength; οὐρά, tail.

ridge (Plate XXIV. fig. 6, *f*) without a fore link; by a still narrower and shorter post-basal ridge, represented by that, *g* (fig. 4 *a*), which curves from the outer part of the base to the inner angle of the hind lobe, along the back part of the crown, that surface sinking a little above the part of the ridge nearest the base of the tooth. The mid link (ib. fig. 6, $m_3$, *r*) is thin, low, or rudimental, yet still traceable from the back part of the inner angle of the anterior lobe to the middle of the base of the fore part of the hind lobe. The contour of the working-surface of the molars is more subquadrate than in *Macropus Titan*, the fore-and-aft diameter being not so much greater than the transverse. The series describes a feeble curve convex outward, but changes anteriorly to a slight concavity through the modification of the premolar at *a*, as above described. The abraded state of $d_4$ contrasts with the almost untouched crown of $p_3$, showing the earlier development of the hinder tooth. The dentine is just exposed on the inner halves of the lobes of $m_1$. The enamel only shows abrasion at the summits of the lobes of $m_2$; the edges of those of $m_3$ are slightly polished by wear anteriorly. This fossil has come from an individual that perished in the prime of life.

In existing Kangaroos the upper premolar of *Macropus ualabatus*, Lesson (Plate XXIV. figs. 1–3, $p_3$), bears the nearest resemblance to that of *Sthenurus Atlas*, and is associated with the same general pattern of working-surface of the molars $d_4$, $m_{1-3}$, except that the fore link and mid link, though feebly developed, are more neatly defined and readily recognizable in the small existing Kangaroo. The figures of both these recent and fossil Kangaroos, or "Wallabies," being of the natural size, preclude the need of stating dimensions.

*Macropus* (*Sthenurus*) *Atlas* was first indicated by a fragment of the under jaw from the Breccia-cave in Wellington Valley. In the type specimen (Plate XXII. figs. 3 & 4) three molars ($d_3$, $d_4$, and $m_1$) are in place; the penultimate molar ($m_2$) is lost; the crown of the last molar ($m_3$) is just rising from the formative alveolus.

The first true molar ($m_1$) affords an instructive comparison and contrast with that in the type specimen of *Macropus Titan* (ib. figs. 17, 18, $m_1$). The grinding-surface of $m_1$ in *Sthenurus Atlas* is broader in proportion to its length, especially behind. The prebasal ridge is narrower and lower; a simple link descending from the fore and outer angle of the front lobe slopes straight to the middle of the summit of the prebasal ridge.

The outer convex borders of the two lobes (ib. fig. 4, $m_1$) are narrower than in *Macropus Titan* (ib. fig. 18, $m_1$), and maintain their breadth, like columns, more uniformly to their summits. The inner borders are rather broader below, but are narrower than in *Macropus Titan*. In *Sthenurus Atlas* the valley between the lobes is both wider transversely and deeper, the link being lower; it slopes from a point rather external to the middle of the front surface of the hind lobe, and runs almost straight down to the middle of the base of the hind surface of the front lobe. The mid link becomes almost obsolete in the last molar (ib. fig. 3, $m_3$). The summits of the lobes bend slightly backward vertically, and from the thickening of the outer and inner angles are feebly concave

across anteriorly. There is a slight swelling of the base of the hind surface of the hind lobe, but not any distinct postbasal ridge.

I have given a new figure of the side view of part of this fossil (Plate XXII. fig. 4)*, and an upper view of the entire fragment (ib. fig. 3), showing the characters of the working-surface of the molars.

In a visit this year to the Geological Museum, Oxford, I was much gratified and interested in finding, in the series of fossils from the freshwater deposits of Darling Downs presented by Sir Charles Nicholson, Bart., M.D., evidence of which I had been long in quest, of the fully, or nearly fully, developed dentition of the lower jaw of *Sthenurus Atlas*. Through Professor Phillips's kind permission, this unique fossil forms the subject of figs. 5–8, Plate XXII. It is a left mandibular ramus, wanting the ascending branch, of a nearly mature individual of *Sthenurus Atlas*.

The last molar ($m_3$) has risen into place, and the summits of its transverse lobes have been just touched by masticatory abrasion, acting from above obliquely backward, without exposing the dentine; but the large and characteristic premolar ($p_3$) has not risen beyond the level of the basal third of the crown of the adjoining molar ($d_4$), and its summit is quite unworn.

This specimen, moreover, gives the mandibular characters of the genus *Sthenurus* as distinguished from those of *Macropus* (ib. figs. 13, 15)—as, *e.g.*, the shorter symphysis (fig. 6, *s*), the larger extent thereon of the articular surface (which reaches to the outlet of the incisor socket), the angle which its lower border makes with that of the horizontal ramus, and the continuation of the upper or diastemal border to the incisor outlet in a direction more nearly parallel with that of the molar alveolar border, not descending so much or so abruptly from that border as it advances forward. The outlet (ib. fig. 5, *v*) of the dental canal is nearer the molar series, and the part of the jaw anterior to the outlet is shorter than in *Macropus Titan*. The depth of the ramus behind the last molar ($m_3$) is relatively greater. The inner surface of the horizontal ramus (ib. fig. 6) is less convex vertically than in *Macropus Titan*.

The symphysial surface, though free or unanchylosed in the not quite mature individual yielding the specimen, must, from its greater vertical extent and uniform flatness, fit closer to its fellow, and permit less divaricating movements of the two rami than in *Macropus*. Besides the anterior outlet (ib. fig. 5, *v*) there is a vascular foramen below $m_1$, midway between the alveolar and inferior borders of the ramus; but this may be an individual character.

The broken border of the ascending ramus shows the fore half of the margin of the wide intercommunicating foramen (ib. fig. 6, *e*), and the fore part of the large cavity from the inner half of which the dental canal is continued forward.

The postalveolar platform has a sharper inner border, and forms a more marked angle at that border, than in *Macropus*, indicating the place of the postalveolar process in *Nototherium*, to which, in the form and proportions of the symphysis, its closer and

* It is shown entire from this view in "Mitchell," *op. cit.* 1st ed. vol. ii. pl. xxix. fig. 1.

firmer junction of the rami, as well as in the characters of *p* 3, the present genus offers a nearer approach than does *Macropus* proper. Moreover, as the socket of the incisor follows the direction of the symphysis, the tooth projects less horizontally than in *Macropus*, and rises at a similar angle with the horizontal lower border of the ramus*. In all the characters of the symphysial end of the mandible *Halmaturus ualabatus* (Plate XXIV. figs. 10, 12) agrees with *Macropus* and differs from *Sthenurus*.

The lower border of the crown of the incisor, with the free end of that tooth, is broken away in the Oxford specimen, but enough of the crown remains to show that it is shorter but vertically broader than in *Macropus* proper. The enamel is confined to the under and outer sides; the radical cement encroaches on the outer enamel in an angular form (Plate XXII. fig. 5, *i*). The upper border of the base of the crown is trenchant; the tooth gradually gains in thickness to the lower border, but even here it is less than half the vertical breadth of the crown; the inner surface, behind the working one, is vertically more concave than in *Macropus Titan*. The hind part of the narrow surface of attrition upon the upper edge of the crown begins half an inch from the hind border of the enamel.

The premolar with a fore-and-aft extent of crown of 8 lines (17 millims.), a vertical extent of 6 lines (12 millims.), and a greatest breadth, near the hind border, of 3 lines ($6\frac{1}{2}$ millims.), is, externally (ib. fig. 5, *p* 3), divided into two subequal lobes; but the vertical fissure runs obliquely backward and inward, so that the lobe forming the anterior half of the outer surface of the crown forms the whole of the inner surface.

This lobe has a slight prebasal prominence, and is divided above by two vertical transverse fissures, the foremost of which is in view on the outer surface, extending nearly halfway down the crown; this fissure widens to the upper border, where the two divisions of the lobe which it separates are linked by a slender longitudinal bar of enamel. The second transverse fissure is not so widened above, but the rudiment of an enamel link appears behind the second transverse division of this lobe; the third division is less definitely cleft or marked off from the rest of the antero-internal lobe, which is continued with a trenchant border to the back part of the crown to which it descends; vertical depressions, hardly to be called fissures, are indicated on the inner surface of this hinder portion of the lobe (Plate XXII. fig. 6, *p* 3). The postero-external lobe (ib. fig. 5, *p* 3) has a simple trenchant edge, describing a slight convexity lengthwise; it is connected with the postinternal lobe by two transverse enamel links, the foremost being the largest (ib. fig. 8, *p* 3).

The outer surface of this complex tooth (*p* 3) is shown in fig. 5, the inner surface in fig. 6, and the upper surface in fig. 8. The homologous tooth in *Halmaturus ualabatus* (Plate XXIV. figs. 10, 11, 12, *p* 3) shows nothing of the complexity answerable to that which renders the upper premolar of that Wallaby so similar to the upper premolar of *Sthenurus*; it has an undivided trenchant crown, slightly thickened behind, with some very feeble indications of vertical grooving on both inner and outer sides. Two teeth

* Compare fig. 6, Plate XXII. with fig. 4, Plate VI. Phil. Trans. 1872.

($d_2$, $d_3$) have been displaced by the rise of $p_3$ in the Oxford specimen of *Sthenurus Atlas* (Plate XXII. figs. 5–8): one of these, viz. $d_3$, is retained in the type specimen (ib. figs. 3 & 4, $d_3$).

The molar following $p_3$ in Plate XXII. figs. 5, 6, 8, answers to $d_4$ in the placental diphyodont dentition*; its crown differs from that of the younger (type) *Sthenurus Atlas* only in a slight superiority of size. The prebasal ridge is linked to near the middle of the front transverse lobe, a little nearer the outer side, making the worn surface there somewhat thicker; the mid link rising from the middle of the base of the hind part of the front lobe rises to join the hind lobe at a similar position, and with a similar result to the grinding-surface. The more produced prebasal ridge of the next molar presses upon the back part of the hind transverse lobe of $d_4$, above the feeble outswelling of the base of that tooth. The fore-and-aft extent of the prebasal ridge, with its linking bar inclining obliquely outward to abut upon the front transverse lobe, characterizes the three true molars, $m_{1,2,3}$. The transverse breadth of the hind lobe of $m_3$ is rather less than that of the front lobe.

The molar series of the present mandible describes a feeble convexity outward. The figures in Plate XXII. being of the natural size precludes the need of recording admeasurements.

The subject of figs. 7 & 8, Plate XXIV., and of fig. 9, Plate XXII., is a portion of the left mandibular ramus (drawn in the Plate without reversing) of *Sthenurus Atlas*, from an older individual than that which afforded the more entire ramus, but retaining the four first molars and part of the socket of the fifth.

The outer and posterior lobe of the premolar (Plate XXII. fig. 9, $p_3$, $b$) has been worn down below the level of the posterior part of the antero-internal lobe (Plate XXIV. figs. 7 & 8, $c$), which stands up as an angular trenchant ridge; on the broader outer lobe a flat field of dentine is exposed, showing that the back part of this premolar, as in *Nototherium*, took some share in mastication, not merely in division of the food as in *Halmaturus ualabatus*; so much of the grooves, ridges, and other accentuations of the crown of $p_3$ as remain in the present specimen repeat those characters in the unworn homologue of the two preceding specimens.

The crown of $d_4$ (Plate XXII. fig. 9) shows a field of dentine enclosed by a border of enamel encroaching by a curved indent in opposite sides, and with a feeble fold at the outer part of what was the prebasal ridge. The dentine of this ridge is worn in $m_1$ into continuity with that of the front lobe, and a small portion of the same tissue is exposed on the back lobe. In $m_2$ the enamelled summits of the transverse lobes are worn obliquely backward, the enamel showing there a finely polished tract. The basal swelling at the back part of this molar is better defined than in the type specimen; in neither is the hind surface of the molars impressed as in *Macropus Titan*. The present specimen agrees in size with the comparable or homotypal parts of the upper jaw (Plate XXIV. figs. 4, 5, 6). The slight difference of size as compared with the mandible

* Phil. Trans. 1870, p. 539, fig. 3 (*Sus*).

of the younger individual (Plate XXII. figs. 5, 6, 8) is well within the limits of individual and sexual range of variety.

The outer surface of the portion of mandible of *Sthenurus Atlas* (Plate XXIV. fig. 7) shows a longitudinal sinuous shallow channel, extending from below the fore part of $p_3$ to $m_1$, at a distance varying from 2 lines to 5 lines below the alveolar border. Below the channel the ramus swells to greater thickness than in the largest of the mandibular fossils of *Macropus Titan*. The lower border has been broken away; and in the longitudinal extent of mandible here preserved, the fractured surface shows a pretty uniform breadth or thickness of 9 lines.

The increase of the fossil (Plate XXIV. fig. 7) over the younger *Sthenurus* (Plate XXII. fig. 5) is shown by the bone more than by the teeth. But even in the smaller specimen (ib. figs. 5, 6) the mandible is relatively stronger and deeper than in *Macropus Titan* (ib. figs. 13, 15). In this species the last four molars ($d_4$ and $m_3$) occupy a longitudinal extent of 2 inches 4 lines, but in *Sthenurus Atlas* of 2 inches. These differential mandibular and dental characters come well out in comparing figs. 5 & 13, and figs. 8 & 14, in Plate XXII.

§ 8. *Sthenurus Brehus*, Ow.—This species is represented by two fossils from the Breccia-cave of Wellington Valley, presented to the British Museum by the Trustees of the Natural-History Museum of Sydney, New South Wales, and forming part of the results of the exploration by Prof. THOMSON and GERARD KREFFT, Esq., carried out with the aid of the legislative grant*.

The specimens formed part of a series of duplicates, thickly encrusted, like those of *Thylacoleo* and *Phascolomys*†, with the reddish stalagmite of the cave.

The most acceptable and instructive results of the clearance of the fossils from their matrix were the subjects of figs. 5–9 of Plate XXVII. The largest specimen (figs. 5 & 6) consists of a portion of cranium including a great part of both maxillaries, with the intervening palatal plates and both palatine bones; the zygomatic masseteric process came out entire on both sides of the skull. The molar series of the left maxillary ($p_3$ to $m_3$) had undergone fracture of the crowns of the two anterior teeth; the portion of the right maxillary included the two posterior molars.

The pattern of the molar crowns closely accords with that of *Sthenurus Atlas*, and the narrow but well-defined prebasal ridge (ib. fig. 6, $m_2$, $f$) was without the link; the mid link (ib. ib. $r$) was represented by a rudiment at the bottom of the valley between the two transverse lobes, $a$, $b$; the postbasal ridge ($g$) was represented by the crescentic border of a depression on the hind surface of the hind lobe; the main ridges were rather narrow antero-posteriorly in proportion to their breadth and vertical extent.

The superiority of size of *Sthenurus Brehus* over *Sthenurus Atlas* may be estimated by comparing figs. 5–9, Plate XXVII., with figs. 4–6, Plate XXIV. The base of the broken premolar (Plate XXVII. fig. 6, $p_3$) shows similar proportions of that tooth, although, as the crown swells out beyond the part retained, this does not yield the whole

* Phil. Trans. 1870, p. 570. † Ib 1871 and 1872.

fore-and-aft extent. Fortunately another cranial fragment of the species (Plate XXVII. figs. 7, 8, 9) included the premolar and adjoining molar entire, and yielded the required subgeneric character of the anterior tooth. The crown is 10 lines in fore-and-aft length, $5\frac{1}{2}$ lines in vertical extent, $4\frac{1}{2}$ lines across the thickest part of the base, which is near the hind end of the tooth. The fore end (figs. 7 & 9, *d*) is subtrenchant, with a prebasal triangular prominence, one angle subsiding halfway along the trenchant fore border. The middle two thirds of the outer surface (fig. 7, *a*) show the usual concavity lengthwise between the smooth and prominent fore (*d*) and hind (*e*) ends of the crown, and on this depressed surface are three vertical obtuse ridges, dividing four shallow linear grooves. The cutting-edge (*a*) similarly sinks below the angular summits of the terminal prominences (*d*, *e*). On the inner side of the crown may first be noticed a low narrow ridge (fig. 8, *f*), extending a few lines backward from the inner basal angle of the prebasal prominence. Above the ridge (*f*) begins the broader rising, which soon stands out as a low inner basal division of the crown; it bends up posteriorly to abut against the inner side of the hind expansion (*e*), leaving a small triangular depression between the buttress and the hind margin of the tooth. The interval between the inner basal lobe or ridge (*b*) and the outer or main part of the tooth is less depressed than in *Sthenurus Atlas*, and does not show the small transverse connecting bars in the hollow. Masticatory attrition has polished the inner side of the blade or outer main part of the crown of this premolar and the inner basal prominence, indicative of a corresponding transverse extension of the crown of the lower premolar. A speck of dentine has been exposed on the buttress. As compared with the upper premolar of *Sthenurus Atlas*, the generic pattern is closely retained, but with the specific modifications above defined.

The crown of the adjoining molar ($d_4$, fig. 9) is worn obliquely from without nearer to the base of the inner side of the tooth. The very narrow prebasal ridge is shown. The dentine exposed on each lobe is broadest at the inner half of the grinding-surface, and it extends in both lobes into an angular form behind, that of the fore lobe indicating the rudimental link, that on the hind lobe the rudimental postbasal ridge.

The third tooth (Plate XXVII. figs. 5 & 6, $m_1$) shows, as in *Sthenurus Atlas* (Plate XXIV. figs. 4–6, $m_1$), a marked increase of size over $d_4$. The prebasal ridge is more developed; the exposed dentinal tracts resemble those in Plate XXVII. fig. 9, $d_4$, but are rather less extensive. The characters of the slightly worn penultimate and last grinders have already been defined, and are sufficiently given in figs. 5 & 6, $m_2$, $m_3$.

The hind border of the bony palate is so entire in the present evidence of *Sthenurus Brehus* as to show that it described a moderate unbroken concave curve, as in *Osphranter robustus*. So much of the palate itself as is preserved suffices to exemplify its correspondence with that and other larger existing Kangaroos (*Macropus major*, *Macropus rufus*, *Phascolagus erubescens*) in the degree of its integrity.

The masseteric process descends opposite the hind lobe of the penultimate molar, and the hind margin of the anterior zygomatic pier is opposite the fore part of the fore lobe of the last molar (ib. fig. 6, $m_3$).

The extent of the alveolar part of the maxillary in advance of the masseteric process is relatively greater than in *Macropus major*, and more resembles that in the Kangaroos, which longer retain the premolar and which have that tooth of larger relative dimensions than in the type of *Macropus* proper. The amount of fracture and variety of distortion which this cave cranial fragment has undergone indicates a persevering exercise and diverse direction of force, such as only accords with the operations of the powerful jaws of a large carnivore.

§ 9. Genus *Protemnodon**, Ow.—The genus *Protemnodon* is allied to *Sthenurus*, but distinguished therefrom chiefly by the more simple trenchant shape of the crown of the premolar.

Having ascertained the characters of that tooth in the upper jaw of *Sthenurus Atlas*, in the specimen from the lacustrine deposits of South Australia (Plate XXIV. figs. 4, 5, 6), I subjected to a reexamination the fossil upper jaw brought to me in 1842 by Count STRZELECKI from the Breccia-cave of Wellington Valley, and the specimen transmitted in the following year from the bed of the Condamine by Col. Sir THOMAS L. MITCHELL, C.B., both of which specimens, from the size of the germ of the premolar (Plate XXIII. figs. 6 & 9), had been referred, in my 'Catalogue of the Fossil Mammalia in the Royal College of Surgeons,' to *Macropus Atlas*†.

I had fortunately begun the quest of this tooth from the inner side of the formative alveolus, and was now able to recognize, in the absence of the inner ridge or lobe characteristic of the upper premolar of *Sthenurus*, and giving the crown of that tooth a breadth corresponding with the lower premolar, that the fossils Nos. 1513, 1519 must belong to another species, and, according to the estimate of the value of premolar modifications, to another subgenus of *Macropodidæ*.

The subsequent acquisition of mandibular fossils, with the premolar simple and trenchant, and with equivalent modifications of the form of the bone, have afforded the requisite ground for proposing the genus, and for referring these maxillary specimens to the species *Macropus Anak*, originally founded on characters of the lower jaw and teeth.

The upper molars of *Protemnodon* are more like those of *Sthenurus Atlas* than of *Macropus Titan*; they have a narrow prebasal ridge without the link. The oblique ridge extending downward and backward from the inner and hinder angle of each chief lobe is more definitely marked, and the two lobes are more alike than in *Sthenurus Atlas*. The breadth of the crown in $m_1$ and $m_2$ of *Protemnodon Anak* (Plate XXIII. figs. 5 & 8) is greater in proportion to the fore-and-aft length than in *Sthenurus*; and the inner border of the two lobes (ib. figs. 6 & 9) is narrower and more sharply pointed than the outer border (ib. figs. 4 & 7), in a more marked degree even than in *Sthenurus*.

Proceeding to the characters afforded by the mandible and teeth (Plates XXV. & XXVI.), I have first to remark that the premolar ($p_3$ in all the figures), in its relative antero-posterior extent to the molars which follow, rather exceeds that tooth in *Sthenurus*

* πρό (before), τέμνω (to cut), ὀδούς (tooth)—in reference to the sectorial form of the anterior molar or premolar.

† 4to, 1845, pp. 325, 327, Nos. 1513, 1519.

*Atlas.* The proportion of $p_3$ in *Protemnodon* is much the same as in the Bettongs*; it is not equal to that in *Dendrolagus dorcocephalus*†. As in this Tree-Kangaroo, the lower molars, like the upper ones, retain the Macropodal bilophodont character. But the lower premolar of *Protemnodon* shows no indication of the three-lobed division which is marked on the outer surface of the crown of that premolar of *Dendrolagus.* It is rather more like that in the Potoroos, though the indications of vertical grooves and ridges on the compressed part of the crown between the slight fore and hind thickened ends are feebler.

The greatest height of the crown of the premolar, which is at the fore part (Plate XXV. figs. 3, 5, 7, & 8, $p_3$), is but half the antero-posterior diameter; the utmost thickness (at the back part of the crown) (ib. fig. 2) is less than the height. The free or trenchant margin is straight, and runs nearly parallel with the base of the crown. The fore border is subtrenchant, the hind one flattened, and closely adpressed against the contiguous molar. The fore part is defined behind by the subsidence of the narrower following part of the crown on the outer side (Plate XXV. fig. 3, $p_3$), and, less definitely, by the foremost of the shallow vertical grooves on the inner side (ib. fig. 8). The base of the fore part of the crown bulges forward beyond the anterior root. The hind part of the crown slightly expands, but is not defined, like the front expansion, from the rest of the crown. A feeble indication of a "cingulum" runs along the outer side of the base of the crown, and is more dubiously represented by a slight smooth outswelling along the base of the inner surface. The tooth is implanted by two antero-posterior, slightly divergent, fangs.

§ 10. *Protemnodon Anak*, Ow.—The subject of Plate XXV. figs. 1 & 2, the type specimen on which the species *Macropus* (*Protemnodon*) *Anak* was founded‡, is a portion of a left mandibular ramus, including the molar series. All the teeth of the permanent dentition are in place, and from the degrees of wear of their crowns it may be inferred that the foremost ($p_3$) was the last to come "into line."

Only the hinder angle of the enamelled trenchant border of the crown of this tooth is touched, whilst the dentine is exposed on the ridges of the last molar (ib. fig. 2, $m_3$). The crown of $d_4$ has been worn down nearly to the bases of the two lobes, and the dentine of the mid link connects the two exposed wide tracts of that tissue, forming the bases of the worn-out ridges. The next molar (ib. ib. $m_1$) shows a greater degree of wear; the dentinal part of the mid link is broader, and the lobes, as seen in the side view (ib. fig. 1, $m_1$), are worn down lower or nearer to their base than in $d_4$. The front lobe of $m_2$ has been abraded to the level of the link, which, being low in this species of *Protemnodon*, is hardly touched. A broad tract of dentine is also exposed on the hind lobe. A narrower bilobed tract appears on the front lobe of $m_3$; the enamelled summit of the hind lobe is smoothly worn downward and backward. The prebasal ridge ($f$) is broadest in this tooth, and shows a low link ($s$) continued

* Philosophical Transactions, 1871, p. 250, fig. 18. † Ibid. fig. 16.

‡ Proceedings of the Geological Society of London, vol. xv. p. 185 (June 23, 1858).

from the fore part of the outer swelling of the front lobe. The inner alveolar border (Plate XXV. fig. 8) runs from the postalveolar ridge (*t*) with a feeble concavity to *m* 1, and then takes as feeble a convex course to the diastema (*l*).

The subject of figs. 1 & 2, Plate XXV., was obtained by HENRY HUGHES, Esq., from the freshwater deposits exposed in the beds of creeks in Darling Downs. It is now in the Museum of the Natural-History Society of Worcester, to the Council of which Society I was indebted in 1858 for the permission to take the above description and figures of this instructive and, at that time, unique fossil.

To Sir DANIEL COOPER, Bart., I have since been indebted for the opportunity of describing and figuring a larger proportion of the left mandibular ramus of the same species of *Protemnodon*, with the molar series at nearly the same stage of attrition. It was discovered by ED. S. HILL, Esq., in the freshwater deposits of Eton Vale, Queensland. Of this fossil I give an external view (Plate XXV. fig. 3), in which it will be observed that, as in the foregoing example, the crown of *m* 1 is more worn (has borne more of the work of mastication) than that of the antecedent molar (*d* 4). I have noted the same circumstance in a *Macropus major* of similar age. This may not relate to an earlier period of *m* 1 coming into the line of work than the molar which precedes it, but more probably is due to the greater degree of pressure upon a tooth nearer the centre of motion of the mandible. The last molar (ib. figs. 3 & 4, *m* 3) shows the narrower hind lobe (*b*): the seemingly broader prebasal ridge (*f*) than in *m* 2 may relate to the less amount of attrition in *m* 3. The links are low and ill-defined in this, as in the type specimen. There is a slight bulge behind, but no indent marking a postbasal ridge in the hindmost molar. The inner vertical plate of the horizontal ramus is continued further back than in existing Kangaroos and Wallabies, forming an inner wall (ib. fig. 8, *t*), with a definite and sharp margin, beneath the base of the coronoid process; and from the point where this hind margin of the inner mandibular plate is continued upward into the coronoid, a low ridge extends on the side of the plate next the large cavity of the ascending ramus forward and downward to the entry of the dental canal. This ridge (Plate XXV. fig. 14, *g*) divides the cavity into an upper (*f*) and lower (*a*) compartment. The structure is repeated, as will be seen, in the specimen next to be described.

The curve and direction of so much of the diastemal ridge (ib. fig. 3, *l*) as is here preserved resemble rather that of *Macropus* and *Halmaturus* than of *Sthenurus*; but the less mutilated specimen (ib. figs. 7 & 8) shows the toothless tract (*l*, *s'*) to be relatively shorter as compared with the molar series than in either of those genera of existing Kangaroos.

This specimen likewise forms part of the series of fossils from the river-beds at Eton Vale, Darling Downs, presented by Sir DANIEL COOPER, Bart., to the British Museum.

The molar series (Plate XXV. figs. 7, 8, 9, *p* 3–*m* 3) agrees in extent and in the proportions of the five teeth with the type specimen, but the fossil is from a less aged individual. The hind angle of the sectorial crown of *p* 3 (fig. 9) is made obtuse and polished by wear.

The dentine exposed on both lobes of *m* 2 is transversely linear, with a slight forward production in both links (*r* and *s*). In *m* 3 a speck of dentine appears on the inner angle of the front lobe (*a*): the enamelled ridges of this and the hind lobe show the oblique polished tract at their hinder surface. The characteristic proportions of both fore and mid links are well shown in *m* 3, and contrast with the better developed ones in the somewhat larger *Protemnodon* represented by the subject of figs. 11, 12, & 13, Plate XXV.

The last molar in *Protemnodon Anak* rises, in the outer side view of the mandible, clear of the front root of the coronoid process (ib. fig. 7, *q*). The fore part of the outer crotaphyte excavation (fig. 7, *f*) sinks as abruptly from the prominent anterior border as in *Macropus* and *Halmaturus*; but the cavity appears to be divided in *Protemnodon* by a curved ridge into an upper (*f*) and lower (*a*) channel, the latter being that which leads to the large hinder orifice of the dental canal. A similar fracture of the ascending ramus of the mandible in existing Kangaroos would not produce this appearance, but it may be due to the minor development and closer approximation to the coronoid plate of the base of the inflected mandibular angle in *Protemnodon.*

In the depth or vertical breadth of the ramus beneath the last molar and the minor degree of vertical convexity of that part, *Protemnodon* contrasts with the narrower and more bulging character of the same part of the jaw in *Macropus.* It is rather less convex, though narrower, in *Halmaturus.* There is a trace at *a*, fig. 8, of the beginning of the excavation, or lower channel, leading to the intercommunicating aperture and to the entry of the dental canal; but the extent of the inner plate of the mandible, from *t* to *a*, is not matched by any existing Kangaroo the lower jaw of which I have compared with the fossil.

In the extent of the edentulous and symphysial part of the mandible (ib. fig. 8, *l*, *s'*) *Protemnodon* agrees with *Halmaturus* rather than with *Macropus*; but the syndesmotic surface extends nearer to the alveolar outlet of the incisor (*i*), although it does not indicate so firm a union as in *Sthenurus* (Plate XXII. fig. 6). It extends more in the axis of the ramus than in *Sthenurus.*

The breadth of the incisor and that of the surface (Plate XXV. fig. 10, *i*) which was opposed to the upper incisors point significantly to a Nototherian tendency.

The configuration of the crown of the unworn molars (ib. figs. 11–13, *m* 2, *m* 3) in a portion of a mandibular ramus of a large *Protemnodon Anak* supplements the illustrations of the mandibular dentition of the species. The fossil was part of an individual in which the hindmost molar had recently risen "into place." The links (fig. 13, *r*, *s*) are more neatly defined in this unworn tooth, which also had not moved forward so clear of the coronoid process (fig. 11) as in the older example (fig. 7).

§ 11. *Protemnodon Og*, Ow.—The subject of figs. 5 & 6, Plate XXV., with a certain increase of size of both mandible and molar teeth, repeats the form and size of the premolar (*p* 3) in *Protemnodon Anak*, but shows a distinct linear indication of the post-basal ridge *g*, and a more definite development of the links *r* and *s* in the last molar, *m* 3.

These characters may be subsequently found in other individuals, and sufficiently evince an established variety; but they are so strongly marked in the still larger mandibular fossils next to be noticed as to justify their ascription to another (zoological) species, and the imposition of the name which heads the present section.

§ 12. *Protemnodon Mimas*, Ow.—In this species a greater depth and thickness of mandible and a concomitant larger size of molars are associated with a relatively smaller size of the trenchant premolar, which does not exceed that in *Protemnodon Anak*. Such character of the variable tooth might be expected, having regard to those which it exhibits in different species of existing Wallabies (*Halmaturus*, Cuv.).

In the present large extinct species of *Protemnodon* a marked modification of the molar teeth accompanies their relative proportions to the premolar, and confirms the taxonomic deductions as to specific status, but does not give ground for assigning thereto subgeneric value.

The postbasal ridge (Plate XXVI. fig 3, *g*) though narrow is definite; the prebasal ridge (ib. *f*) is proportionately as well developed as in *Protemnodon Anak*; its "link" (ib. *s*) also, and that (ib. *r*) of the two chief lobes, are more distinct than in the type species.

The smaller mandible and teeth (Plate XXV. figs. 7 & 8) cannot have come from a younger specimen of the present species; both molars and premolars are more worn, and prove that fossil to have been derived from an older Kangaroo than the animal which owned the subject of the present description.

The premolar of *Protemnodon Mimas* (Plate XXVI. fig. 1, $p_3$) shows on the outer side of the intermediate part of its crown five vertical grooves and four ridges, more strongly developed than in *Protemnodon Anak*; these are, in part, worn smooth on that side of the tooth of the subject of fig. 7, Plate XXV. For the rest, the characters of the premolar of the larger species are those of *Protemnodon Anak*.

The crown of $d_4$, figs. 1–3, has suffered more from fracture than abrasion. A linear tract of dentine is exposed in each transverse lobe of $m_1$, slightly expanding at the origin of the "link" from near the outer end of their anterior surface. Only the enamel shows abrasion in $m_2$. The crown of $m_3$ is entire, has but recently risen into place, and, contrasted with that tooth in the subject of fig. 13, Plate XXV., exemplifies the coronal character of the molars of the present well-marked species. It is partially concealed in a direct outer side view by the coronoid process, *q*, fig. 1, Plate XXVI.

For this fine evidence of *Protemnodon Mimas* I am indebted to my friend Dr. GEORGE BENNETT, F.L.S., of Sydney, New South Wales, who obtained it from the freshwater deposits forming the bed of "Gowrie Creek," Darling Downs.

From the same fertile district, but in another locality (Eton Vale), Sir DANIEL COOPER, Bart., received and presented to the British Museum the portions of mandible (Plate XXIV. figs. 13 & 14, and Plate XXVI. figs. 4 & 5), little, if at all, exceeding in size the corresponding part of that of *Macropus major* or *Macropus rufus*. The best-preserved

molar in each of these fossils indicated, however, a larger species. This molar, moreover, presented good differential characters in the presence of the well-defined, though small, postbasal ridge (ib. fig. 7, *g*), the large prebasal ridge (ib. *f*), and the well-developed and almost equal-sized fore link (*s*) and mid link (*r*); the proportions of the two principal transverse lobes in the minor breadth of their outer and inner convex borders as compared with their height were rather those of *Sthenurus* than of *Macropus*. But *Sthenurus Atlas* shows no postbasal ridge (comp. Plate XXIV. fig. 15, *Protemnodon Mimas*, with the same view, Plate XXII. fig. 8, of the homologous tooth in *Sthenurus*).

On the hypothesis that the specimens Plate XXIV. figs. 13–16 and Plate XXVI. figs. 4 & 5 belonged to the same species as the specimen Plate XXVI. figs. 1 & 2, the last, largest and best-preserved unworn molar in the smaller jaws would be homologous with the antepenultimate and worn molar in the larger jaw. The test-scrutiny was accordingly applied, and the germ of the large premolar characteristic of the genus *Protemnodon* was brought to light in both the smaller fossils (Plate XXIV. fig. 14, $p_3$, Plate XXVI. fig. 5, $p_3$). The Kangaroos leaving these remains had each perished at the same phase of dentition as that shown in the type specimen of *Sthenurus Atlas* (Plate XXII. figs. 3 & 4); the subgeneric characters afforded by the premolar are well exemplified thereby. The comparatively flat undivided outer surface, with the continuous straight trenchant margin of the crown of $p_3$ in *Protemnodon*, contrasts with the two convex lobes defined by the median fissure notching the trenchant margin and deeply grooving the outer surface of the crown of $p_3$ in *Sthenurus*; and these differences are better marked in the originals than in the figures above cited, although these give the details with quite sufficient accuracy.

The mandibular fossils of the young *Protemnodon* supply acceptable additional evidence of the dental characters of the species. Thus the crown of $d_4$, which is mutilated in the type mandible (Plate XXVI. fig. 3), is entire in figs. 4 & 6, save as regards the degree of masticatory abrasion to which it has been subject, exposing a linear tract of dentine on each main lobe expanding where the link joins such lobe. The postbasal ridge (Plate XXIV. fig. 13, $d_4$) is as conspicuous in this as in the succeeding tooth, $m_1$; the prebasal ridge shows also a proportionate development, with the fore link distinct (Plate XXVI. fig. 6, $d_4$, *s*). The first and second deciduous molars (ib. $d_2$, $d_3$) occupied an alveolar extent of 9 lines; they were displaced, as usual, by the rise of the premolar with a crown of corresponding antero-posterior extent. The subject of figs. 13–15, Plate XXIV., was from a younger animal than that of figs. 4–6, Plate XXVI.; in the former the molar ($m_1$) had very recently risen into place; in Plate XXVI. figs. 4–6 the enamelled summits of the transverse ridges of $m_1$ are a little worn, as usual, from above downward and backward.

The socket of the incisor in the subject of fig. 4 is broken across about an inch from its closed end; the fracture (ib. fig. 8, *i*) gives, therefore, the breadth and thick-

ness of the front tooth at that part, which would be, at least, the same as that of the exserted crown of the large procumbent incisor in *Protemnodon Mimas.*

Of the upper jaw and teeth of this species (*Protemnodon Mimas*) my present evidence consists of photographs of the natural size of a specimen obtained by Professor THOMSON and Mr. KREFFT in the Breccia-cave of Wellington Valley, and deposited in the Museum of the Natural-History Society of Sydney, New South Wales.

The photographs, liberally transmitted to me by the Trustees of that Museum, and prepared under the superintendence of their able Curator, Mr. KREFFT, give an outer side view (Plate XXVII. fig. 1), an inner side view of part of the left premaxillary and teeth (ib. fig. 2), an inner side view of the premolar (ib. fig. 3), and a view of the grinding-surface of the two best-preserved molars ($d_4$, $m_1$, left side, ib. fig. 4). These teeth, the premolar of the left side, and perhaps the front and second incisor are tolerably perfect; the remaining teeth have suffered more or less fracture; but the remains of the molar series *in situ* on the left side enable the requisite admeasurements and comparisons as to size to be made with the mandibular teeth of *Protemnodon* previously described. From their close accordance in this character with the mandibular teeth of *Protemnodon Mimas* (Plate XXVI. figs. 1–3) I refer the subject of the photographs to that species.

The upper incisors, as in existing *Macropodidæ*, are three in number in each premaxillary. The foremost (Plate XXVII. fig. 1, $i_1$) is curved lengthwise, with the convexity forward, and has a thick enamelled crown, with the fore part convex transversely; its convex cutting-edge projects slightly beyond that of the second incisor. The crown of this tooth ($i_2$) is smaller, less convex, and less prominent than that of the foremost one. The indications of the socket of the third incisor support the inference that, as in the large existing Kangaroos (*Macropus major*, *Macropus* (*Osphranter*) *robustus*, *Macropus* (*Osphranter*) *rufus*), the antero-posterior dimension of the crown of that tooth exceeded that of the second and first incisors; but of the precise proportions of these teeth exemplifying specimens are still *desiderata*.

The antero-posterior extent of the incisive alveoli of the left premaxillary is 1 inch 5 lines, that of the toothless interval between the third incisor and the premolar is 1 inch 9 lines; the extent of the molar series is 3 inches 2 lines. The diastema is relatively shorter than in the above-cited existing Kangaroos, and indicates a corresponding condition of the lower jaw, whereby, as regards length, *Protemnodon* resembles *Sthenurus*.

The premolar ($p_3$), however, retains in the upper jaw the more simple trenchant form which afforded the subgeneric distinction in the homotypal tooth below. There is a slight expansion of the fore and hind parts of the crown, the intermediate part of the blade having an entire and nearly straight trenchant edge, with the indication of a low ridge or cingulum along the base. The corresponding part on the inner side of the crown (ib. fig. 3), though much less developed than in the upper premolar of *Sthenurus*, adds another character differentiating *Protemnodon Mimas* from *Protemnodon Anak*.

The bilophodont molars have both pre- and postbasal ridges; the former, as usual in upper molars, less produced than in the lower molars. The indication of the fore link is recognizable, and that between the main lobes is more plainly shown (Plate XXVII. fig. 4); the mid link is worn down to the base, exposing a broader tract of dentine in the foremost ($d_4$) and a linear tract in the next tooth ($m_1$). A broad field of dentine had been brought to the grinding-surface in both molars. Mr. KREFFT has noted on one of the photographs of a fossil upper jaw, which I refer to *Protemnodon Mimas*, "Molars worn down, premolar in good condition"—an appearance which is the consequence of the later development of the front tooth of the series. The crowns of the other molar teeth seem to have suffered mutilation from fracture in the original of the photograph. The maxillo-premaxillary suture (between 21 and 22 in Plate XXVII. fig. 1) is unmistakable in the photograph; anterior to it, in a line with the hind part of the last incisive socket, the premaxillary has suffered fracture. The extent of the diastema contributed by the maxillary (21) is 1 inch 1 line. The course of the suture resembles that in *Halmaturus*; it does not describe an angle or curve forward before ascending obliquely backward to the nasal, as in *Macropus major*.

If photographs alone, such as those in Plate XXVII. figs. 1–4, of which I have given the foregoing interpretation, should be thought insufficient evidence of an extinct species, I may remark that the characters of *Protemnodon Mimas*, and the determination of that species of extinct Kangaroo, are independent of them, and are sufficiently exemplified in the fossil remains of the mandible and mandibular teeth of this gigantic Wallaby.

§ 13. *Protemnodon Rœchus*, Ow.—The subject of figs. 10–13, Plate XXVII., from King's Creek, Clifton Station, presented by the proprietor, GEORGE KING, Esq., is a part of a left mandibular ramus, with the permanent dentition, save the last molar, in place and use; and, from the degree of attrition of the crown of $m_2$, it is plain that $m_3$ had risen into place, and been lost with the supporting part of the jaw by mutilation of the fossil. The retained molars have characters of those of *Protemnodon Anak*, in wanting the postbasal ridge (fig. 13), and having the links less sharply defined (fig. 12) than in *Protemnodon Mimas*. But the increase of size is more than can be granted to difference of sex. The protemnodont pattern of premolar is closely adhered to; the hind swelling of the crown (ib. fig. 10, *b*) is relatively somewhat greater than in *Protemnodon Anak*, and a smooth triturating surface has been worn upon its summit; the trenchant border is abraded, as usual, upon its outer side. The anterior lesser expansion is defined externally by an oblique, not vertical groove. The lower border as well as both ends of the mandible have been broken or worn away.

The preserved teeth describe a slight curve, convex inward—a character (if it be specific) which is not shown by any of the other and smaller kinds of extinct Kangaroos forming the subject of the present communication. In this I have continued the practice, began in my Appendix to MITCHELL'S work (1838), of attaching the names of giants, familiar to the students of biblical and mediæval histories, to the several extinct species which towered of old above the tallest of the living Kangaroos.

## Description of the Plates.

### PLATE XX.

Fig. 1. Side view of the cranium and teeth of a nearly full-grown Uroo (*Macropus* (*Phascolagus*) *erubescens*).

Fig. 2. Working-surface of the molars, left side, upper jaw, of a nearly full-grown Uroo.

Fig. 3. Inner surface of the molars, left side, upper jaw, of a nearly full-grown Uroo.

Fig. 4. Outer side view of mandible and teeth of the same skull.

Fig. 5. Working-surface of the lower deciduous molars of the same skull.

Fig. 6. Side view of molar series, left side, upper jaw, of a younger *Phascolagus erubescens*.

Fig. 7. Working-surface of the molars in place of a younger *Phascolagus erubescens*.

Fig. 8. Side view of portion of mandible, with the molar series, of the same skull; the germ of the premolar is exposed in its formative cell.

Fig. 9. Side view of molar series, left side, upper jaw, of a young Red-necked Kangaroo, *Macropus* (*Halmaturus*) *ruficollis*.

Fig. 10. Side view of molar series, left side, lower jaw, of the same skull.

Fig. 11. Side view of the left mandibular ramus and teeth of the yellow-foot Kangaroo, *Macropus* (*Petrogale*) *xanthopus*.

Fig. 12. Working-surface of upper molars, right side, of *Macropus* (*Boriogale*) *magnus*.

Fig. 12 *a*. Side view of three anterior lower molars of *Boriogale magnus*.

Fig. 13. Side view of the left mandibular ramus and teeth of *Macropus* (*Osphranter*) *robustus*.

Fig. 14. Working-surface of the molar series of ditto. 14′. *a*, side view of upper premolar; *b*, working-surface of ditto.

Fig. 15. Side view of the left mandibular ramus and teeth of the Giant Kangaroo, *Macropus major*.

Fig. 16. Working-surface of the molar series of the Great Kangaroo.

Fig. 17. Side view of the left upper incisors, *Macropus major*.

Fig. 18. Idem, *Osphranter robustus*.

Fig. 19. Idem, *Boriogale magnus*.

Fig. 20. Idem, *Halmaturus ualabatus*.

Fig. 21. Idem, *Halmaturus ruficollis*.

Fig. 22. Idem, *Petrogale xanthopus*.

Fig. 23. Working-surface of left upper molar ($m_2$), *Macropus major*.

Fig. 24. Idem, *Macropus rufus*.

Fig. 25. Idem, *Osphranter antilopinus*.

Fig. 26. Working-surface of left lower molar ($m_2$), *Boriogale magnus*.

Fig. 27. Working-surface of left upper molar ($m_2$), *Halmaturus ualabatus*.

Fig. 28. Idem, *Petrogale xanthopus*.

Fig. 29. Working-surface of left lower molar, *Macropus Titan.*
Fig. 30. Idem, *Sthenurus Atlas.*

## PLATE XXI.

Fig. 1. Working-surface of right upper molars, *Macropus major.*
Fig. 2. Idem, *Macropus rufus.*
Fig. 3. Idem, *Osphranter robustus.*
Fig. 4. Working-surface of right lower molars, *Macropus rufus.*
Fig. 5. Idem, *Boriogale magnus.*
Fig. 6. Outer side view of left maxillary bone and molar series of a young *Macropus Titan.*
Fig. 7. Inner side view of left maxillary bone and molar series of a young *Macropus Titan.*
Fig. 8. Working-surface of molars of left maxillary bone of a young *Macropus Titan.*
Fig. 9. Back view of the same fossil, showing formative cell of the last molar, $m_3$.
Fig. 10. Palatal or under view of a left maxillary, with working-surface of the molar teeth of an older *Macropus Titan.*
Fig. 11. Working-surface of right upper molar series of a mature *Macropus Titan.*
Fig. 12. Working-surface of the last two lower molars, right side, *Macropus Titan.*
Fig. 13. Outer side view of the same teeth, with outline of part of mandible.
Fig. 14. Inner side view of the same teeth, with outline of part of mandible.
Fig. 15. Under or palatal view of right maxillary bone and teeth of an old *Macropus Titan.*
Fig. 16. Outer side view of right maxillary bone and teeth of an old *Macropus Titan.*
Fig. 17. Inner side view of teeth of right maxillary bone of an old *Macropus Titan.*
Fig. 18. Hind surface of last upper molar ($m_3$) of an old *Macropus Titan.*

## PLATE XXII.

Fig. 1. Outer side view of part of right maxillary and teeth of a young *Phascolagus altus*; the premolar ($p_3$) and penultimate molar ($m_2$) are exposed in their formative alveoli.
Fig. 2. Under view of the same specimen.
Fig. 3. Upper view of portion of right mandibular ramus, showing the working-surface of the molars in place, and of the crown of the last molar ($m_3$) in its formative alveolus, of a young *Sthenurus Atlas.*
Fig. 4. Outer side view of part of the same specimen, with the crown of the premolar exposed in its formative alveolus. (These figures are from the type specimen of *Macropus Atlas*, Ow., figured in MITCHELL'S 'Three Expeditions,' &c., 8vo, vol. ii. 1838, p. 359, pl. xxix. fig. 1.)

Fig. 5. Outside view of a larger portion of the left mandibular ramus of an older individual of *Sthenurus Atlas*; the premolar ($p$ 3) has not quite risen into place.

Fig. 6. Inside view of the same specimen.

Fig. 7. Upper view of symphysis and incisor of the same specimen.

Fig. 8. Working-surface of the molars of the same specimen.

Fig. 9. Working-surface of the lower molars of a full-grown or mature individual of a large male of *Sthenurus Atlas* (or of a larger species of *Sthenurus*).

Fig. 10. Outside view of part of left maxilla and teeth of a mature individual of *Macropus Titan*.

Fig. 11. Under view, with working-surface of molars, of the same specimen.

Fig. 12. Inner side view of the same specimen.

Fig. 13. Outside view of major part of the left mandibular ramus and teeth of a mature individual of *Macropus Titan*.

Fig. 14. Working-surface of the molars of the same specimen.

Fig. 15. Inside view of the same specimen.

Fig. 16. Upper view of part of the symphysis and incisor of the same specimen.

Fig. 17. Upper view of a small portion of the right mandibular ramus of a young *Macropus Titan*.

Fig. 18. Outer side view of the same specimen, with the germ of the premolar ($p$ 3) exposed in its formative alveolus. (This is the type specimen of *Macropus Titan* figured in MITCHELL'S 'Three Expeditions,' &c., p. 359, pl. xxix. fig. 3.)

## PLATE XXIII.

Fig. 1. Outer side view of right maxillary, with the molar teeth and their roots exposed, of a large old male *Macropus rufus*.

Fig. 2. Outer side view of right maxillary and teeth of *Macropus Titan*. (From the specimen No. 1519, 'Fossil Mammalia,' in the Museum of the Royal College of Surgeons: Catalogue of Fossils, 4to, 1845, p. 324.)

Fig. 3. Under view, with working-surface of the teeth, of the same specimen.

Fig. 4. Outer side view of portion of right maxillary and teeth of a young *Protemnodon Anak*.

Fig. 5. Working-surface of the teeth of the same specimen.

Fig. 6. Inner side view of the same specimen, with the premolar ($p$ 3) exposed in its formative cavity. (From the specimen No. 1519, 'Fossil Mammalia,' in the Museum of the Royal College of Surgeons; wrongly ascribed to *Macropus Atlas* in my 'Catalogue,' 4to, 1845, p. 327.)

Fig. 7. Outer side view of portion of the left maxillary of a young *Protemnodon Anak*.

Fig. 8. Working-surface of the teeth of the same specimen.

Fig. 9. Inner side view of the same specimen, with the premolar ($p$ 3) exposed in its formative cavity. (From the specimen No. 1513, 'Fossil Mammalia,' in the

Museum of the Royal College of Surgeons; wrongly ascribed to *Macropus Atlas* in my 'Catalogue,' 4to, 1845, p. 325.)

Fig. 10. Inner side view of part of the left mandibular ramus and teeth of *Macropus affinis*, Ow.

Fig. 11. Working-surface of the best-preserved molars ($m_1$, $m_2$) of the same fossil. (This is the type specimen of the species, No. 1524, 'Fossil Mammalia,' in the Museum of the Royal College of Surgeons: 'Catalogue,' 4to, 1845, p. 328.)

Fig. 12. Outside view of portion of right mandible, with last three molars, of an old (female?) *Macropus Titan*.

Fig. 13. Working-surface of the teeth of the same specimen.

Fig. 14. Corresponding portion of lower jaw of *Macropus rufus*. (From the largest existing Kangaroo, obtained by JOHN GOULD, Esq., F.R.S., during his sojourn in Australia.)

Fig. 15. Outside view of portion of left mandibular ramus and four molars of an immature *Osphranter Gouldii*, Ow.

Fig. 16. Working-surface of the teeth of the same specimen.

## PLATE XXIV.

Fig. 1. Outer side view of skull and upper teeth of a nearly mature *Halmaturus ualabatus*.

Fig. 2. Inner side view of molar series of ditto.

Fig. 3. Working-surface of molar series, and portion of bony palate, of ditto.

Fig. 4. Outer side view of right maxillary bone and teeth of a full-grown *Sthenurus Atlas*.

Fig. 4 *a*. Hind view of penultimate molar ($\dot{m}_2$) of ditto.

Fig. 5. Inner side view of the same fossil.

Fig. 6. Under view of ditto, with working-surface of teeth.

Fig. 7. Outer side view of portion of mandibular ramus and teeth of a mature *Sthenurus Atlas*.

Fig. 8. Inner side view of the same fossil.

Fig. 9. Hinder surface of the crown of penultimate molar ($m_2$) of ditto.

Fig. 10. Outer side view of mandibular ramus and teeth of a nearly mature *Halmaturus ualabatus*.

Fig. 11. Working-surface of molar series of ditto.

Fig. 12. Inner side view of the same mandibular ramus and teeth.

Fig. 13. Outer side view of a portion of the right mandibular ramus and tooth of a young *Protemnodon Mimas*.

Fig. 14. Inner side view of the same fossil, with the premolar ($p_3$) exposed in its formative cavity.

Fig. 15. Working-surface of the molar ($m_1$) of the same fossil.

Fig. 16. Back view of the molar ($m_1$), with part of the formative cavity of $m_2$, of the same fossil.

Fig. 17. Inner side view of fore part of the mandibular ramus of an *Osphranter Cooperi.*

Fig. 18. Outer side view of the three molars, $p_3$, $d_4$, $m_1$, of ditto.

## PLATE XXV.

Fig. 1. Outside view of portion of mandibular ramus, with the molar series, of a full-grown *Protemnodon Anak.*

Fig. 2. Working-surface of the teeth of the same fossil.

Fig. 3. Outside view of a larger portion of a mandibular ramus, with the molar series, of *Protemnodon Anak.*

Fig. 4. Working-surface of the two hindmost molars of the same fossil.

Fig. 5. Outside view of a portion of a mandibular ramus and molar series of a *Protemnodon Og.*

Fig. 6. Working-surface of the teeth of the same fossil.

Fig. 7. Outside view of a left mandibular ramus, nearly entire, with incisor and molar teeth, of *Protemnodon Anak.*

Fig. 8. Inside view of a left mandibular ramus, nearly entire, with incisor and molar teeth, of *Protemnodon Anak.*

Fig. 9. Working-surface of the molar series of the same fossil.

Fig. 10. Upper view of symphysial part, with the incisor, of the same fossil.

Fig. 11. Outside view of a portion of mandible, with last two molars, of *Protemnodon Og.*

Fig. 12. Inside view of a portion of mandible, with last two molars, of *Protemnodon Og.*

Fig. 13. Working-surface of the two molars, $m_2$, $m_3$.

Fig. 14. Hinder fractured surface of the mandibular ramus of *Protemnodon Anak* (fig. 3).

## PLATE XXVI.

Fig. 1. Outside view of part of left mandibular ramus, with the molar series, of a mature *Protemnodon Mimas.*

Fig. 2. Inside view of part of left mandibular ramus, with the molar series, of a mature *Protemnodon Mimas.*

Fig. 3. Working-surface of the teeth of the same fossil.

Fig. 4. Inside view of part of the left mandibular ramus of a young *Protemnodon Mimas.*

Fig. 5. Outside view of the same fossil, with the premolar ($p_3$) exposed in its formative cavity.

Fig. 6. Working-surface of the molars preserved in the same fossil.

Fig. 7. Working-surface of the first lower molar ($m_1$) of the specimen, fig. 14, Plate XXIV., of a young *Protemnodon Mimas.*

Fig. 8. Fractured anterior end of specimen, fig. 4, with section of alveolus of incisor (*i*).

Fig. 9. Upper view of a large portion of the mandible and molar series of a full-grown *Macropus Titan*.

Fig. 10. Working-surface of the lower molars ($m_2$, $m_3$), with remains of $m_1$ and $d_4$, of an older (female?) *Macropus Titan*.

Fig. 11. Outer side view of a nearly entire right mandibular ramus, with the fore part of the left ramus of the same jaw attached by matrix, of a (male?) *Macropus Titan*.

Fig. 12. Inner side view of symphysial part of right ramus of the same fossil.

Fig. 13. Inner side view of part of right mandibular ramus of a larger individual, or variety, of *Macropus Titan*.

Fig. 14. Working-surface of last molar ($m_3$) of the same fossil.

Fig. 15. Hinder surface of the same molar.

## PLATE XXVII.

Fig. 1. Left side view of fore part of cranium and teeth of *Protemnodon Mimas*.

Fig. 2. Right side view of part of premaxillary and broken incisors of the same fossil.

Fig. 3. Inner side view of left premolar of the same fossil.

Fig. 4. Working-surface of the right upper molars ($d_4$, $m_1$) of the same fossil. (The above four figures are from photographs of the specimens now in the Museum of Natural History, Sydney, New South Wales.)

Fig. 5. Left side view of part of cranium and teeth of *Sthenurus Brehus*.

Fig. 6. Under or palatal view of the same fossil.

Fig. 7. Outer side view of left upper premolar ($p_3$) and following molar ($d_4$) of *Sthenurus Brehus*; with fore end view of $p_3$.

Fig. 8. Inner side view of the same teeth.

Fig. 9. Working-surface of the same teeth.

Fig. 10. Outer side view of part of left mandibular ramus and teeth of a mature *Protemnodon Rœchus*.

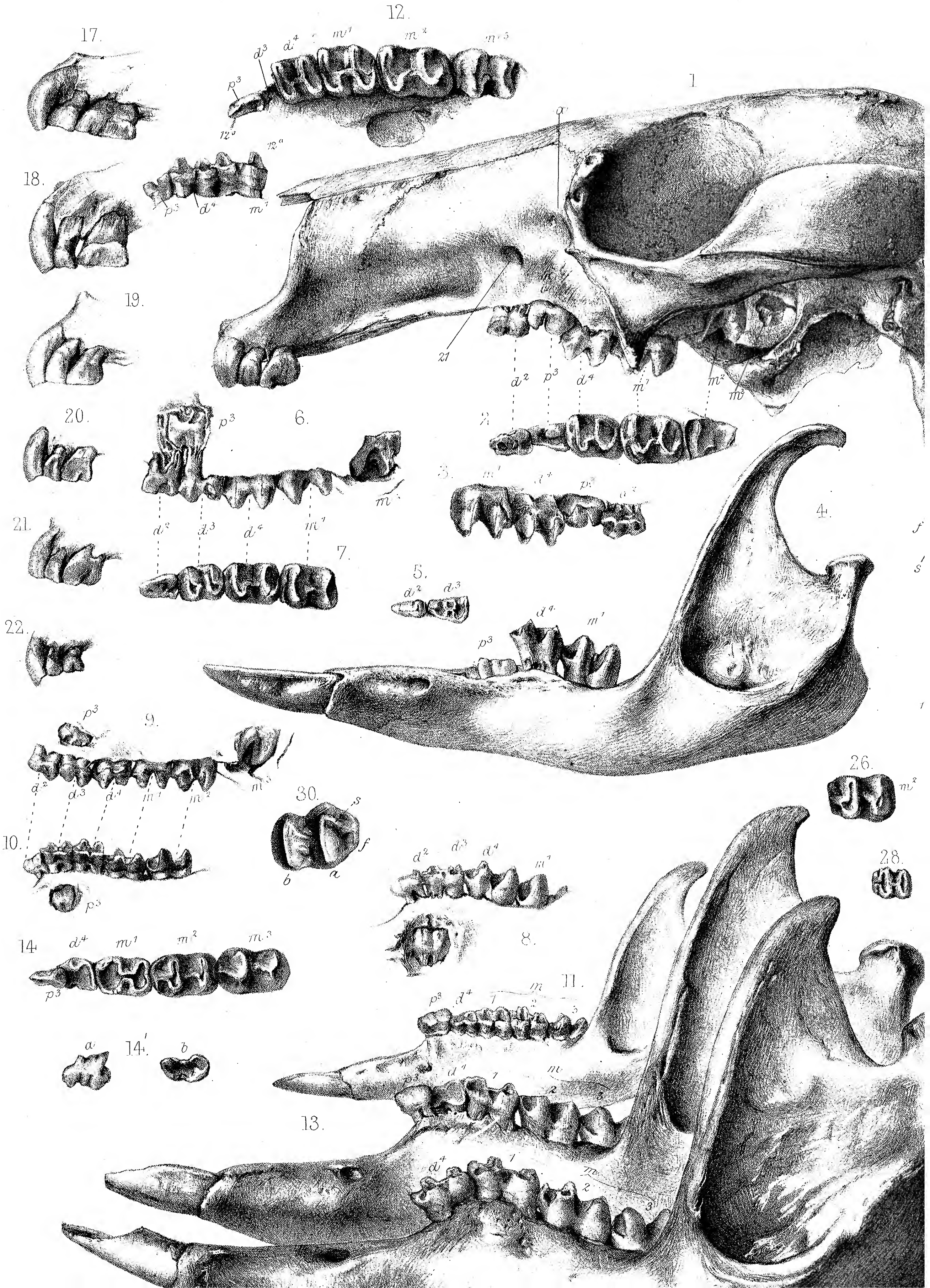
Fig. 11. Inner side view of the same fossil.

Fig. 12. Working-surface of the teeth of the same fossil.

Fig. 13. Hind surface of the molar ($m_2$) of the same fossil.

Fig. 14. Portion of palate and of right molar series of *Protemnodon Mimas*. (From a photograph of the specimen in the Museum of Natural History, Sydney, New South Wales.)

All the figures are of the natural size.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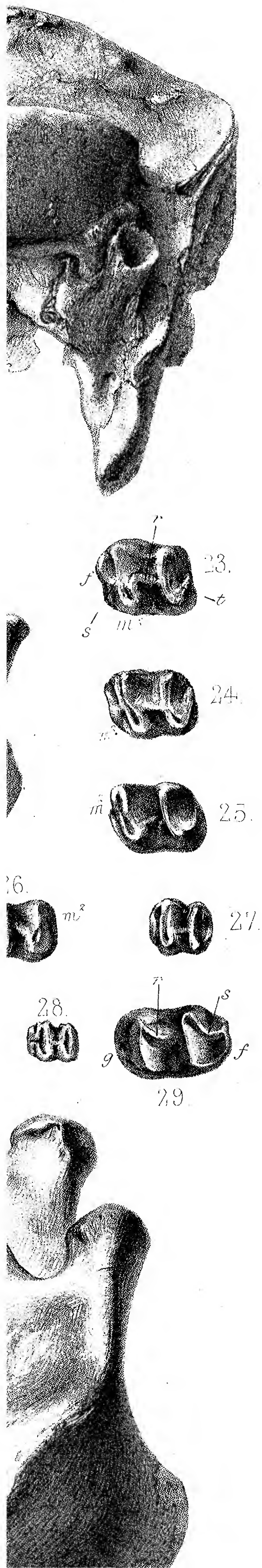
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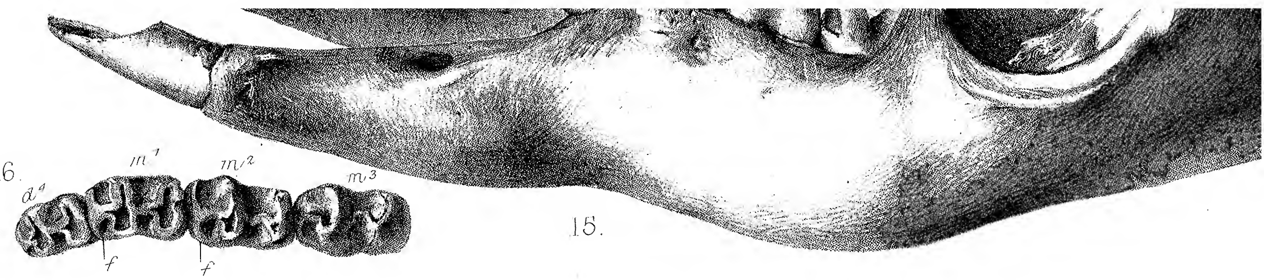


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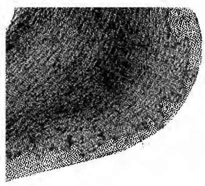

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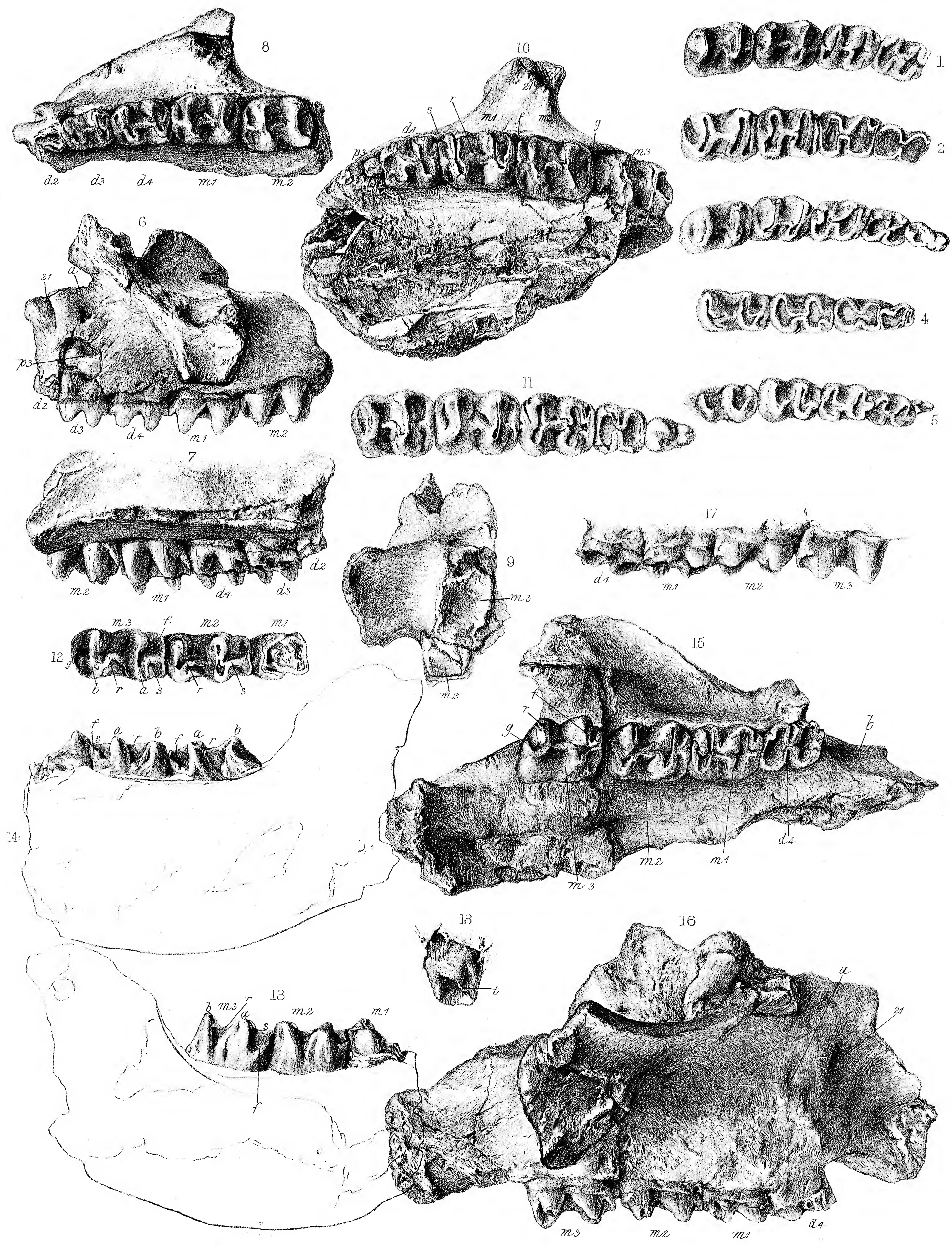
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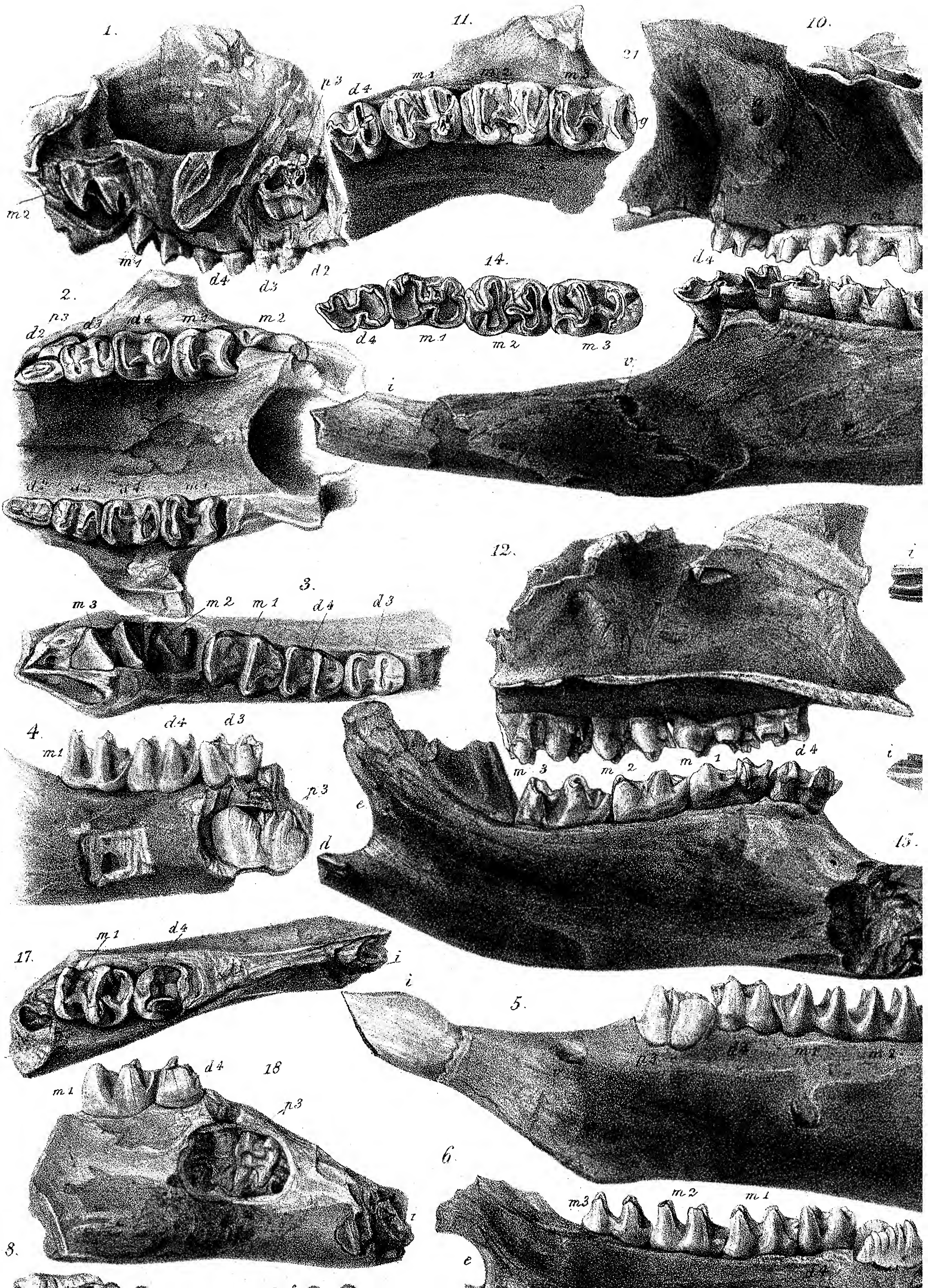

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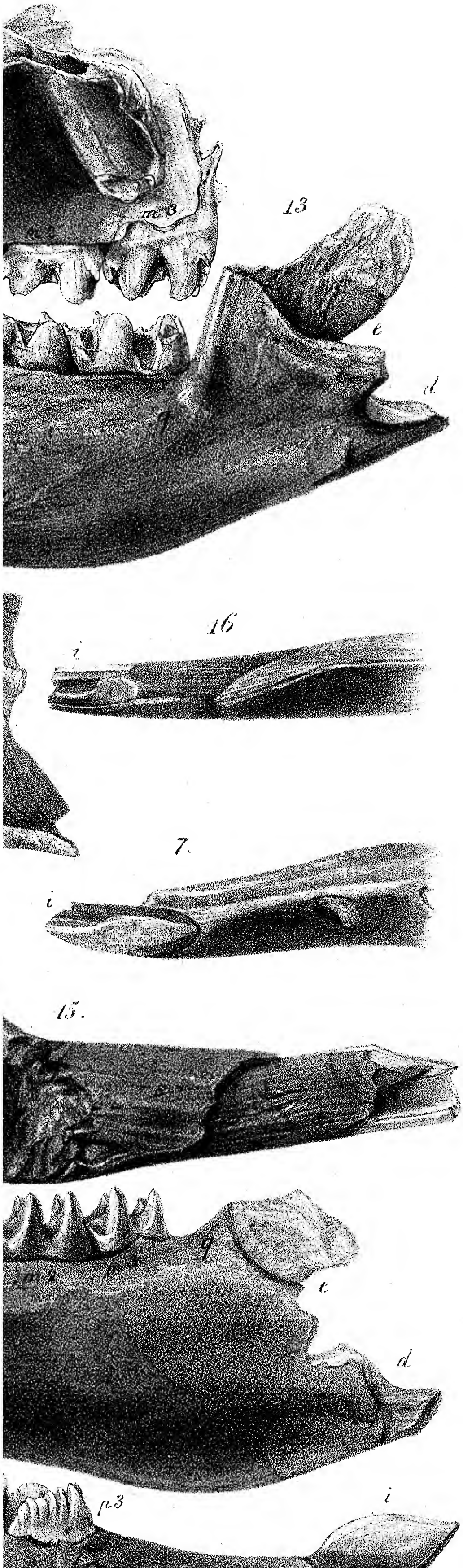
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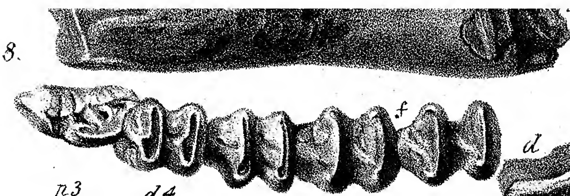


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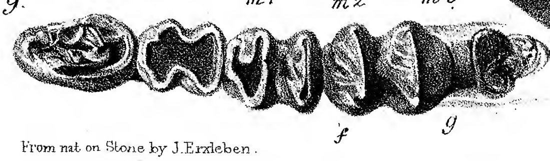


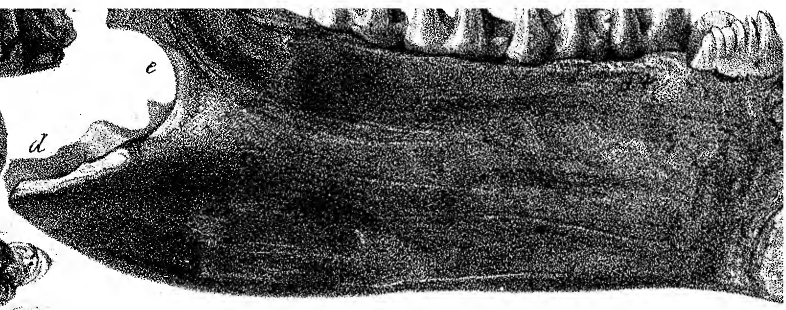


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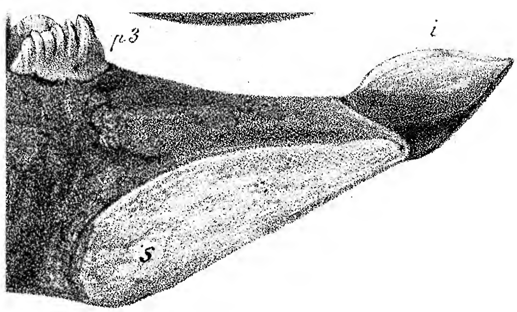


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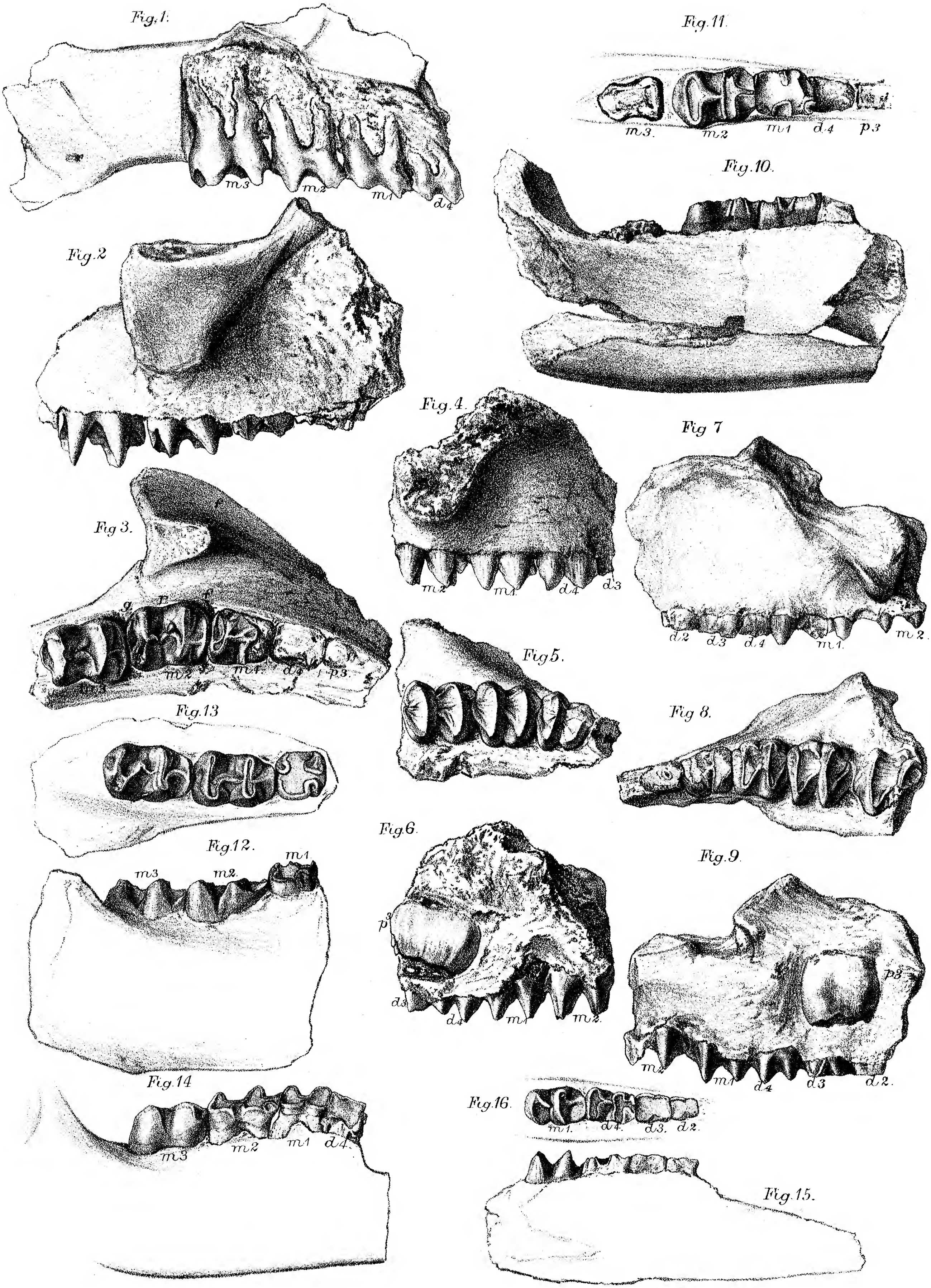


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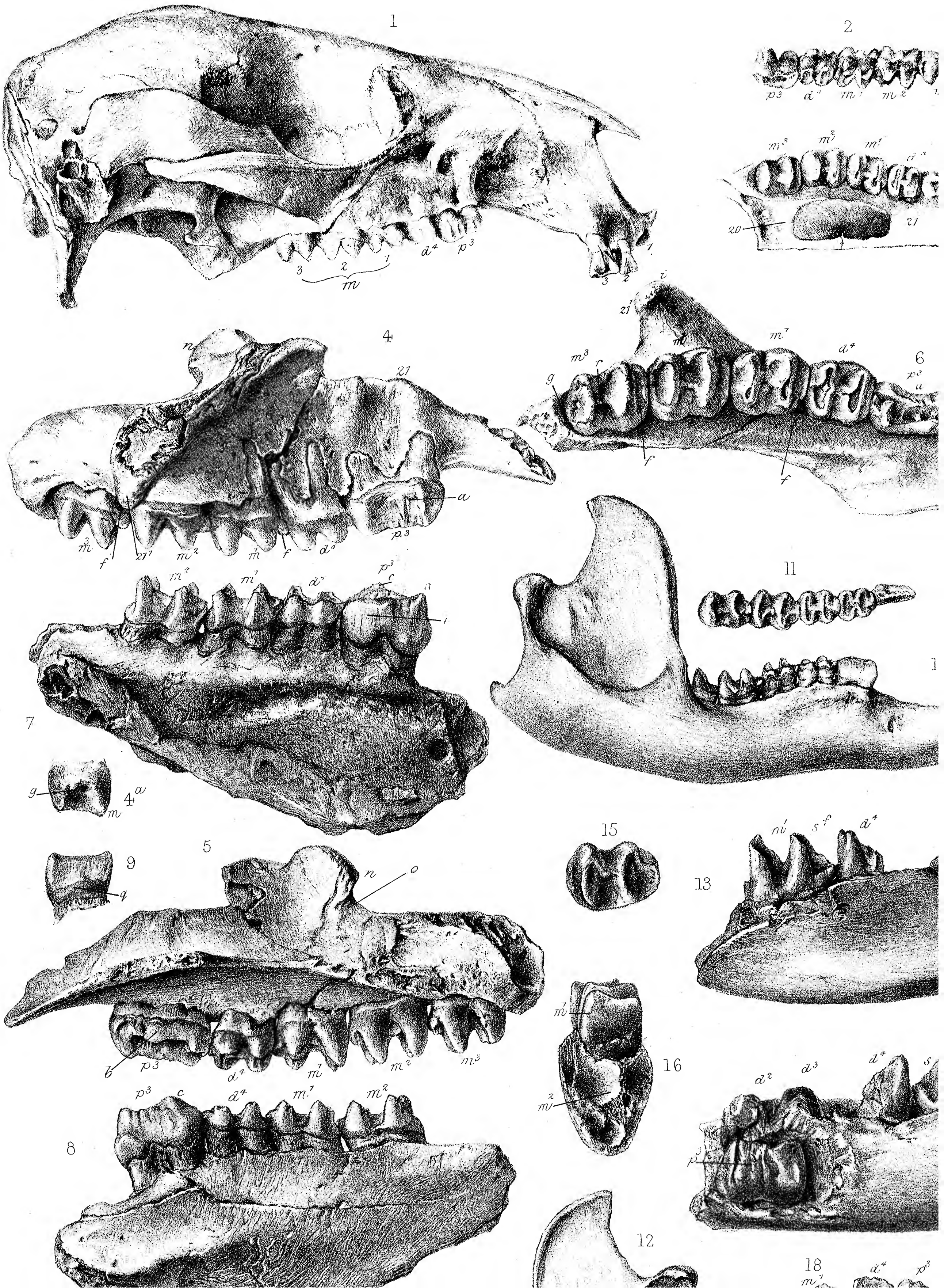
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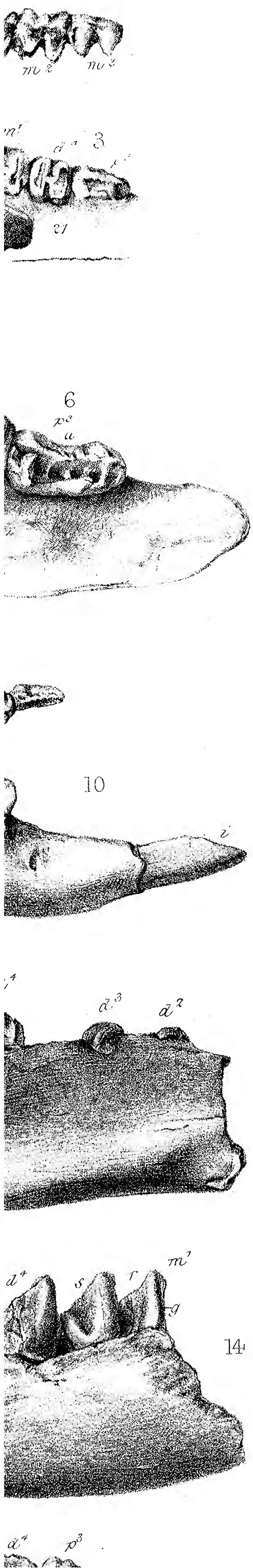
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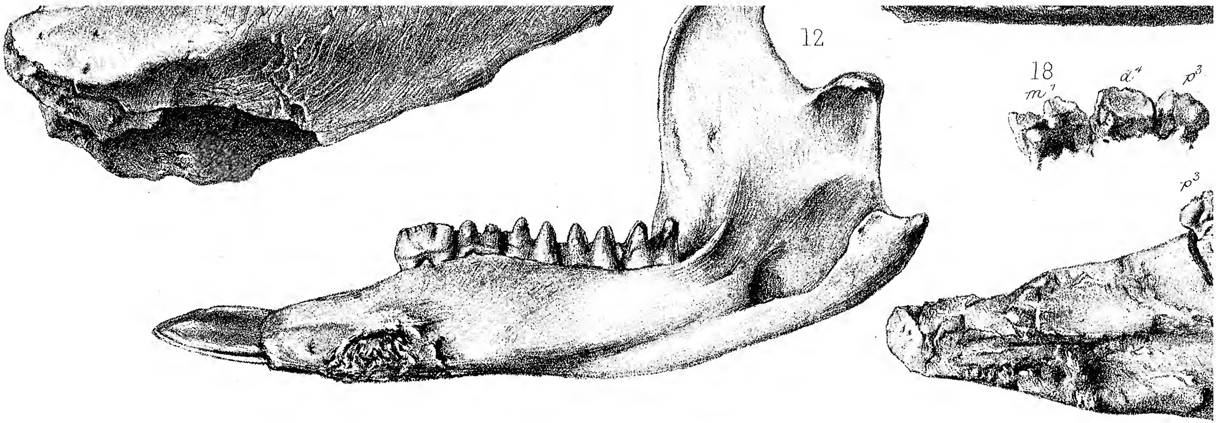


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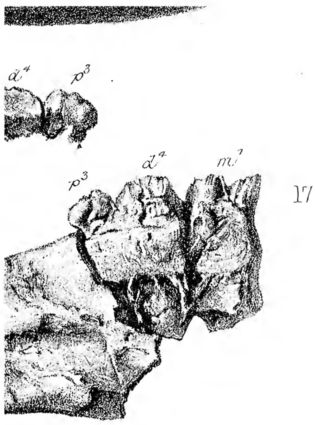


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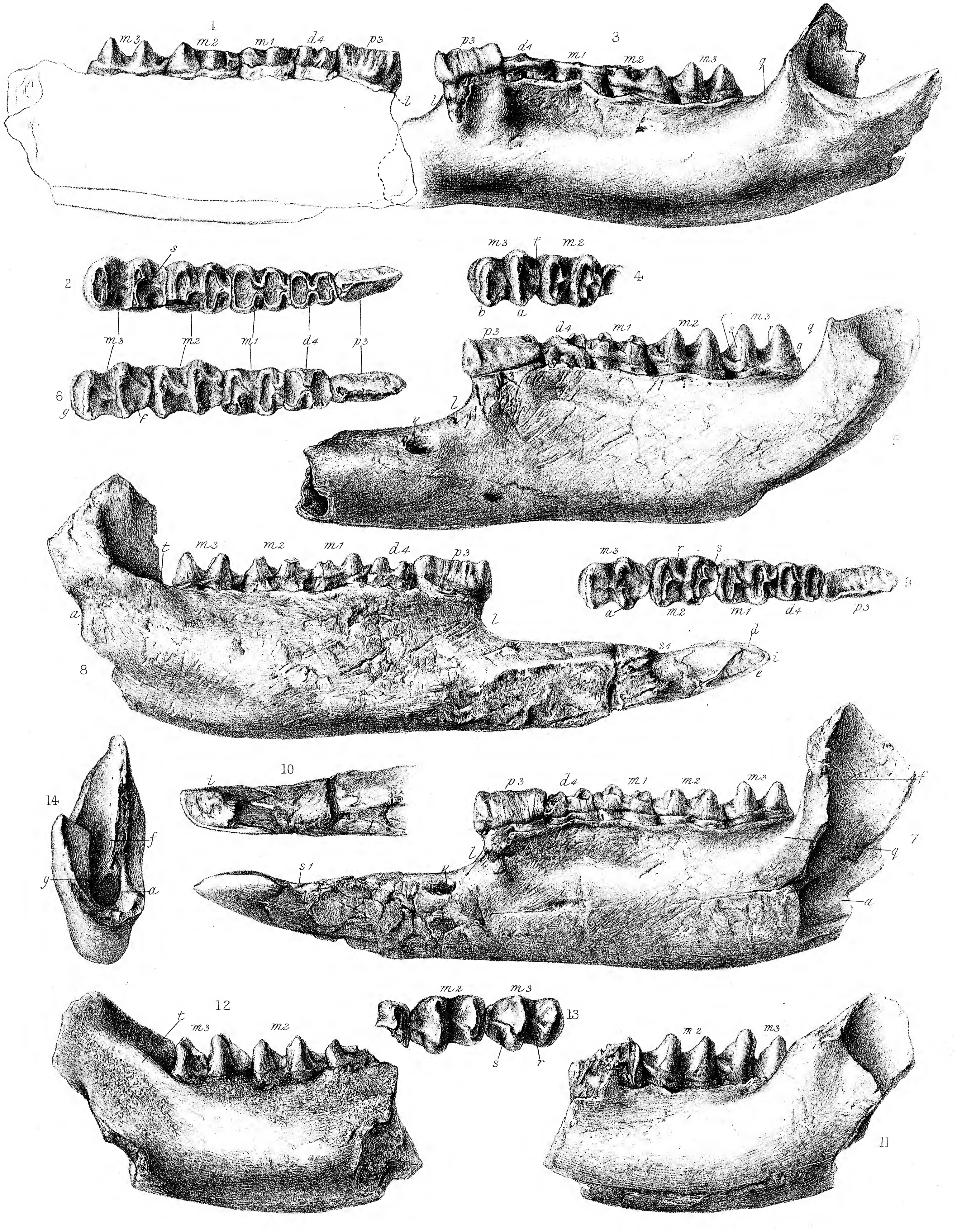


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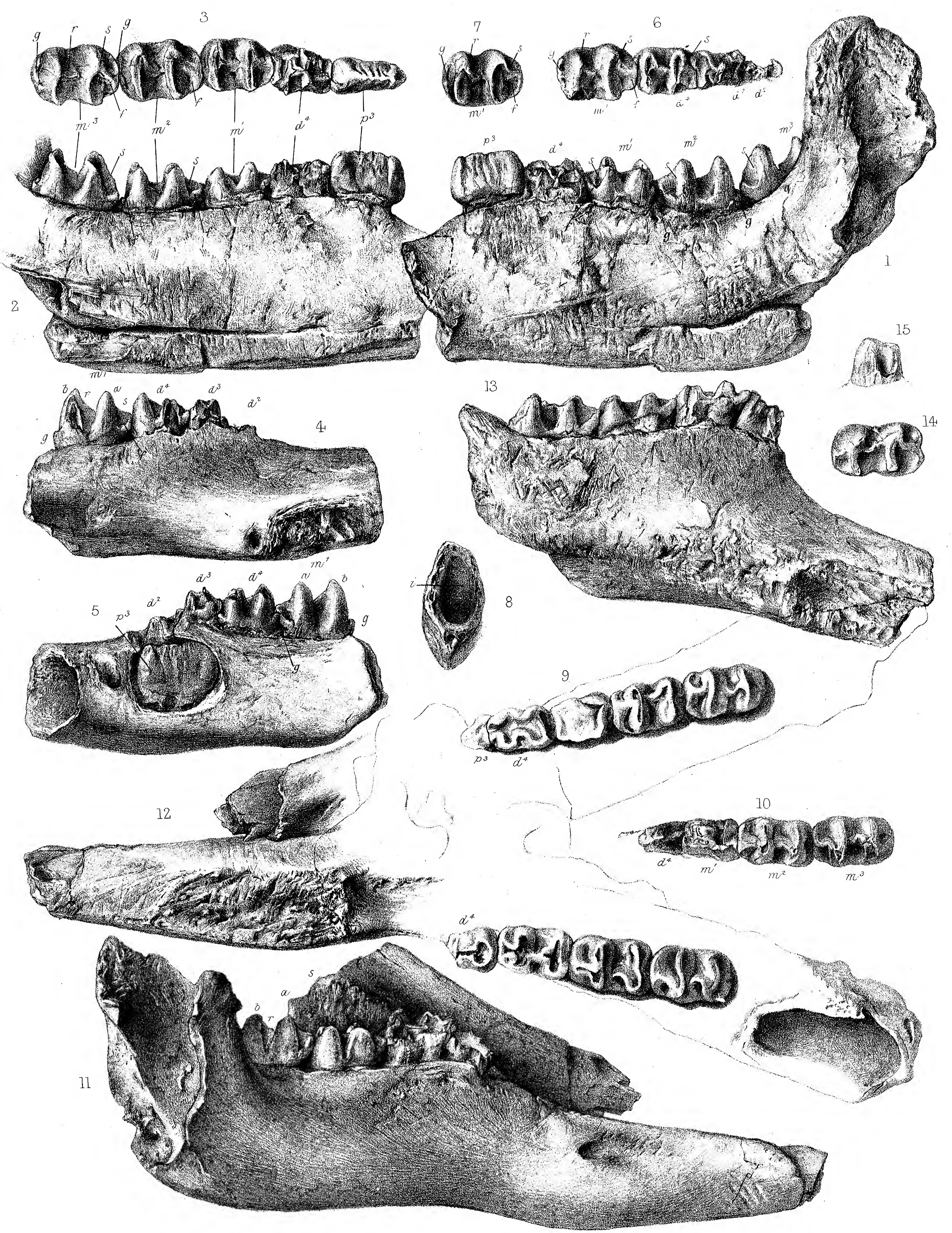
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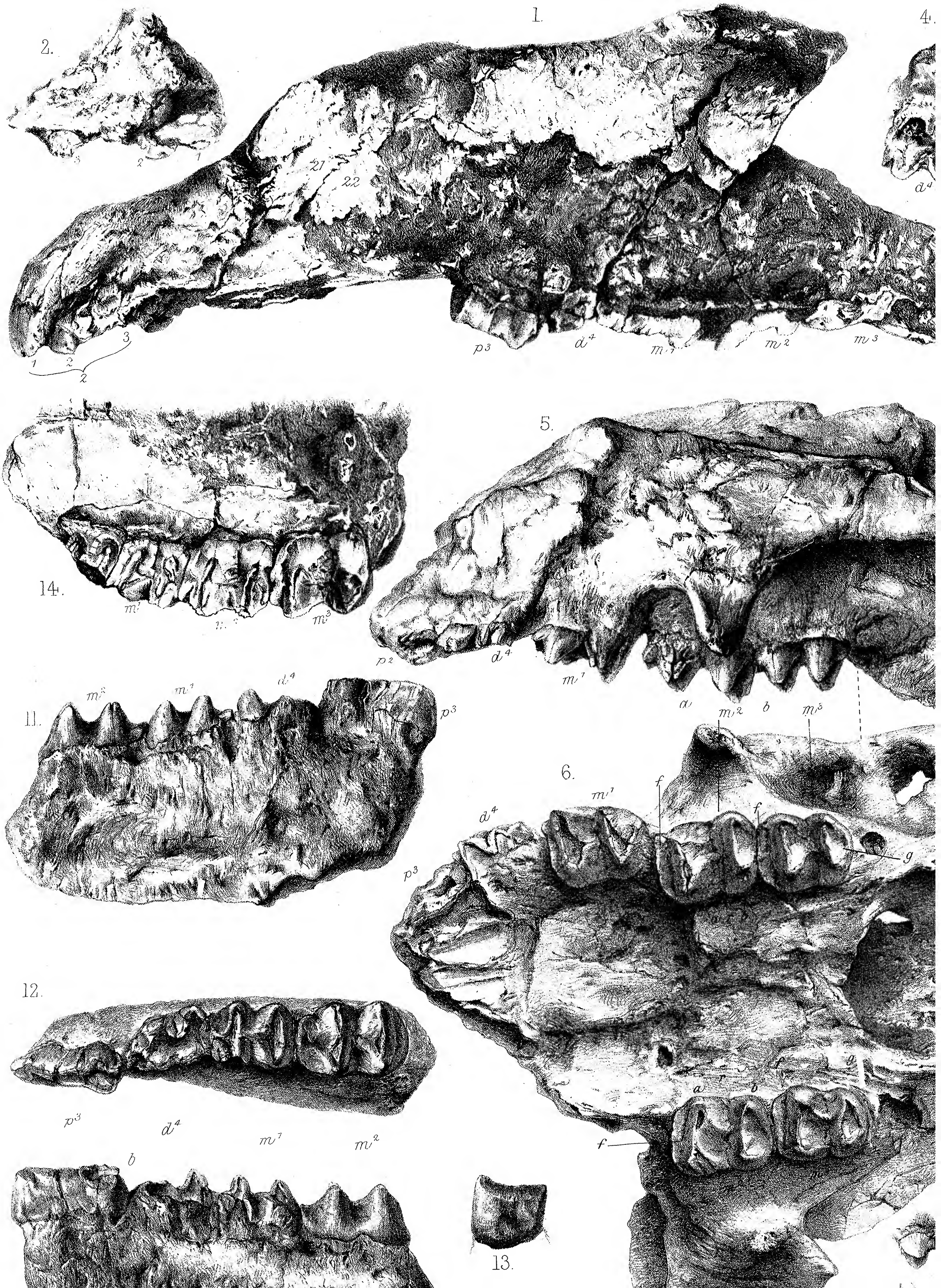
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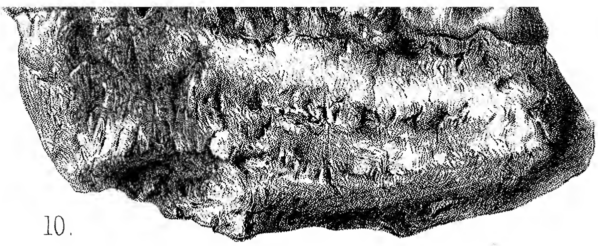

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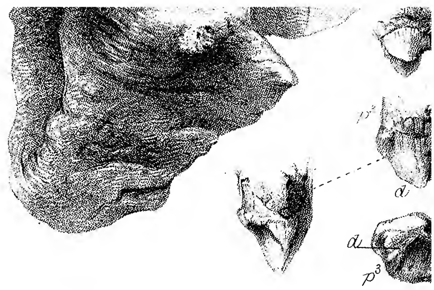


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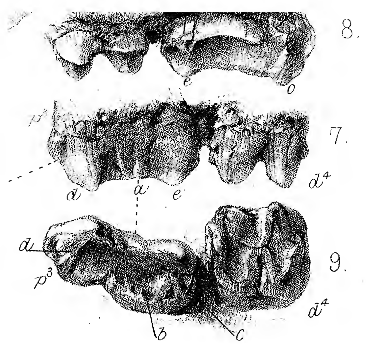


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